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BANKING SECTOR AND CENTRAL BANK IN DEVELOPING COUNTRIES: THE CASE OF IRAN USING A DSGE MODEL

Abstract

Banking sector as one of the most important sector in developing countries plays a major role in the economic stability of the countries. In this paper and with the help of DSGE model we investigate the importance of banking system and the role of central bank in shifting economic shocks across the society.

The analysis of the effects of oil and financial shocks on real variables of the economy indicates that the adopted model is well-matched with theoretical expectations and facts. Results of the model endorse the importance of the banking sector in reassigning the impact of the shocks and we also show that liquidity injections by central bank relieve financial instability in the short run.

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1. Introduction

Financial markets have a significant role in funding investments and are considered the backbone of economic development in developing countries. The empirical evidence associated with the recent financial crisis has also implied a significant role of financial sector in shifting monetary policy toward the real sector of the economy and major cause of business cycle (Jermann and Quadrini 2009). To better understand the sources of economic fluctuation and design an effective economic policy, we separately examine the role of financial intermediaries in both money and capital markets.

Whereas short term financing through money markets is the main objective of commercial banks and credit institutions, capital markets are considered to be the main source of financing long term funding for productive activities in manufacturing and services industries.

Despite the recent progress to enhance the scope of capital markets in Iran, Central Bank and the banking system as a whole remains to be the leading source of fund for the entire economy. In other words banking system performs two distinct functions.

Since all the deposits at commercial banks are insured by the Central Bank, and the Central Bank is influentially controlled by the government, on one hand the banking system is responsible for supply of money and allocation of deposits among semi-private commercial banks and on the other hand it takes an active role in payment management and distribution of funds among producers and investors. Consequently, financial surplus unit's main financial instruments for saving are banks' certificate of deposits (with regulated interest rate) and bonds issued either by the government or commercial banks and the deficit units' have no choice but to rely on the implemented policy of financial authorities regarding the allocation of funds. To this extent, any deficiency of funds in the financial markets coupled with an inefficient performance of policy makers leads to monetary shock and negative spill over to other sectors of the economy.

The main objective of this paper is to build a dynamic stochastic general equilibrium model with regarding banking sector and central bank role in financial crises. We introduce negative market book shock and negative oil shock and compare our simulation results to Iran data.

In this paper, section 2 presents literature review. Section 3 gives methodology. Section 4 presents the model. Conclusion provided at section 5.

2. **Literature review**

Over the past decade the relation between fiscal and monetary policies, role of banks as financial intermediaries and interbank market in transferring shocks to the real sector of the economy have become an important research field of research for academies and a very visible objective for policymakers.

An external economic shock is an event that causes a significant change within an economy, despite occurring outside of it. economic shocks are unpredictable and may typically impact either sides of the market, thus shifting economic shocks across society in Real Business Cycle (RBC) models is considered as for how the important economic variables affected by financial, market book and oil shocks (Medina 2005).

A major lesson of the financial crisis is that the interbank lending market is crucial for banks that face uncertainty regarding their liquidity needs. The interbank market funds, will reduce the overdraft of the central bank and reduce the cost of liquidity management, it also reduces inflationary effects of overdraft.

Iran's interbank market was established in 2008, initially with 10 members but today has 18 members. Statistical research shows considerable growth from 2008 to 2015 which indicates banks' reliance on each other's surplus funds in short term.

Figure 1. Growth rate of interbank market volume
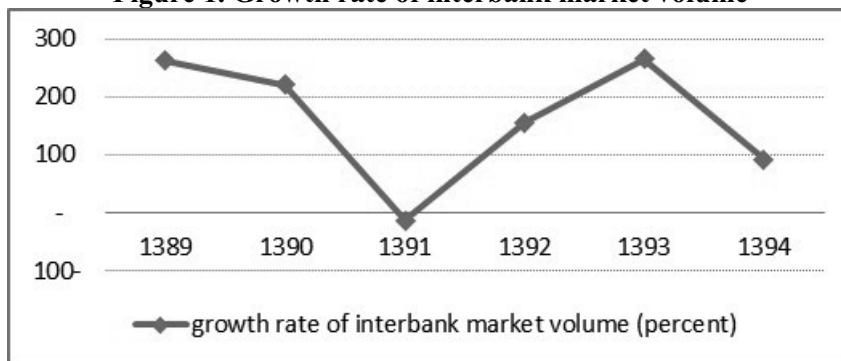
Source: Central Bank of Iran

Sargent and Wallace (1981) showed that the monetary policy cannot reduce inflation in the short and the long term without major changes in

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fiscal policy, in other words; they raised the dominance of fiscal policy in which fiscal authorities compensate their budget deficits by issue debt securities and realizing that monetary authorities do not have the power to control inflation. If monetary authorities impose tighter monetary policies to control the inflation, the interest rate will rise and the deficit will increase further due to the government's financial obligations. Depending on the method of deficit financing, the economy may face even higher inflation than before.

After the banking crisis started in 2007, the importance of a relationship between the banking sector and the real sector was more apparent than ever before. Therefore transmission of shocks from the banking sector to the real sector was entered into the DSGE modeling. In the literature on closed economy models, the two main ways in which an active banking system is incorporated into DSGE models with financial friction, is through the external finance premium proposed in Bernanke, Gertler and Gilchrist (BGG 1999) or through Collateral constraint tied to real estate values for entrepreneurs proposed in Iacoviello (2005). Gerali et al. (2010), Smets and Wouters (2007) designed DSGE models based on the framework of the banking sector, the households and firms, While the banking sector and financial intermediaries receive deposits from households and supply credit to firms. Iacoviello (2011) introduces a banking sector with one bank and focuses on how financial shocks (repayment shocks) affect an economy with patient and impatient households.

This group of studies has not addressed the role of the interbank markets as the balance sheet shocks transmitted to the real economy, but the effect of shocks as banks' default shocks on the real sector has been discussed. The results represent reduced credit supply and thus reduce economic growth.

De Walque and et al (2010), are considered Interbank market and regulatory sectors at DSGE. In this model, they have considered the interaction between the banking system and the real sector of the economy and importance of stabilizing the financial sector and regulatory policy. The model is calibrated against real US data and used for simulations. they show that Basel regulation reduces the steady state but improves the resilience of the economy to shocks and that moving from Basel I to Basel II is procyclical.

Goodhart et al. (2005), this paper proposes a model to assess risk for banks. Its main innovation is to incorporate endogenous interaction among banks, where the actual risk an individual bank bears also depends on its

interaction with other banks and investors. they develop a two-period general equilibrium model with three active heterogeneous banks, incomplete markets, and endogenous default. The model is calibrated against UK banking data and therefore can be implemented as a risk assessment tool for regulators and central banks.

Dib (2010) the author proposes a micro-founded framework that incorporates an active banking sector into a dynamic stochastic general-equilibrium model with a financial accelerator. He evaluates the role of the banking sector in the transmission and propagation of the real effects of aggregate shocks and assesses the importance of financial shocks in U.S. business cycle fluctuations. The banking sector consists of two types of profit maximizing banks that offer different banking services and transact in an interbank market. Loans are produced using interbank borrowing and bank capital subject to a regulatory capital requirement. Banks have monopoly power, set nominal deposit and prime lending rates, choose their leverage ratio and their portfolio composition, and can endogenously default on a fraction of their interbank borrowing. Because it is costly to raise capital to satisfy the regulatory capital requirement, the banking sector attenuates the real effects of financial shocks, reduces macroeconomic volatilities, and helps stabilize the economy. The model also includes two unconventional monetary policies (quantitative and qualitative easing) that reduce the negative impacts of financial crises.

Goodfriend and McCallum (2007) and Christiano et al. (2007) formulate quantitative models to assess the relevance of a detailed banking sector (and hence the importance of distinguishing among the various short term interest rates) for monetary policy. Gerali et al. (2010) augment these papers by introducing imperfect competition among banks.

All the papers mentioned above use homogeneous banks and the interbank market either collapses or amounts to a connection with the central bank. But Giri (2014) has considered two types of banks. Banks are faced with shortage liquidity for credit supply and thus borrowing from the interbank market and giving credit to the real sector, the second group of banks that have excess funds, lend to interbank and invest less risky assets such as bonds. Results suggest that Credit shocks in the interbank market have reduced the supply of loans from the banking sector to the real sector of the economy, and then has reduced Investment and economic growth.

The followings are the two studies about Iran's economic bank sector in a DSGE model.

ShahHosseini (2013) in her Ph.D. thesis investigated inter relationship between the banking system and real variable of macroeconomics in Iran and developed a DSGE model considering the banking sector as an intermediary and its performance on banks with different shocks. Addition of banking sector in DSGE model and its experimental evaluation reveals that this sector has an important role in Iran's real business cycles. They noticed that existing monetary shock effects in non-performing loans shows that such loans lead to decreasing the efficiency of monetary shocks.

Mehregan and Daliri (2011) investigated banks reaction to monetary policies based on a DSGE model by using Quarterly data between years (1991-2009). In this study, they designed DSGE frameworks with respect to intermediaries to investigate the thinking of investors and loan seekers in society, through the monetary shocks.

The results suggest that monetary shocks will increase nominal variables such as wages, prices, and interest rate.

3. Methodology

DSGE models are built on microeconomic foundations and emphasize agents' intertemporal choice. The dependence of current choices on future uncertain outcomes makes the models dynamic and assigns a central role to agents' expectations in the determination of current macroeconomic outcomes. In addition, the models' general equilibrium nature captures the interaction between policy actions and agents' behavior.

These models can help to identify sources of fluctuations, forecast and predict the effects of policy changes, and perform counterfactual experiments. They also allow establishing a link between structural features of the economy and reduced form parameters, something that was not always possible with the large scale of macroeconomic models. Given the difficulty of constructing accurate DSGE models, most Central banks still rely on traditional marc econometric models for short-term forecasting.

In this paper, we investigate the importance of banking system with endogenous default probabilities and examine the role of the central bank as a stabilizing factor by injecting funds in the market to alleviate financial fluctuation. We have used a modified model of Gregory de Walqe, Olivier Pierrard and Abdul-Aziz Rouabah (Olivier Pierrard 2008). In their model, banking system provides loans to firms in order to satisfy their capital requirements for new investments. On the other hand, banks acquire their

funds through household's deposits and pay a fixed interest rate, until end of the contract.

In this paper, banks are divided into two groups, one those who have excess liquidity and the other those who have liquidity deficit. In this situation the first group of banks provides loans to the second group through an interbank market and also interbank rate can change during the time. To allow for the presence of credit risk, we introduce the endogenous probability of default for firms and banking sector.

Also, all sectors (households, firms, and banks) either maximize utility or profits subject to their budget constraint. Capital requirements rules should be observed as a commitment for banks and a Central bank has the authority to interfere in the interbank market.

3.1 Developing a DSGE Model Considering Banking Sector with respect to Iran's Economy

To adjust for a more realistic situation in developing countries, contrary to usual assumption of classical RBC models we are not assuming perfect competition in capital markets. We also added oil production based on available oil reserves and quota set by OPEC, as an exogenous variable in AR (1) format.

Based on the historical evidence (in Iran economy) there is no possibility of default for households depositor, in other words, there is no risk for household's deposits. Reserves and assets requirements of the banks are controlled by a supervisory authority.

Therefore there are 5 sectors (households, firms, banks, the central bank, and oil) in the model. We can illustrate the relation of these sectors as follows:

Figure 2. Flows between agents
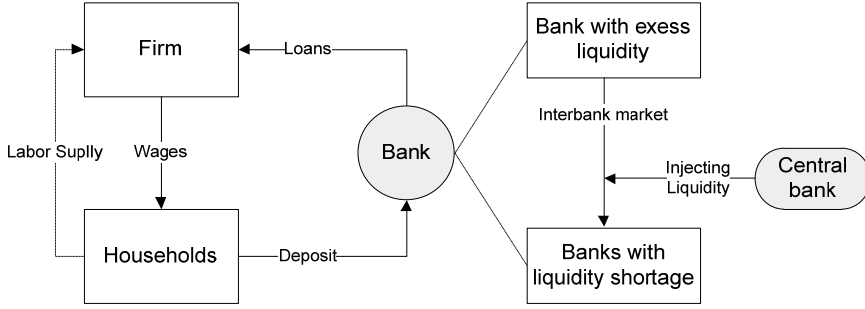
3.1.1 Firms

The Primary objective of firms is to acquire a number of loans needed to maximize their profit as an (Elul 2008). Even though there is a possibility for firms to default their loans, they must pay some high pecuniary and non-pecuniary costs. Pecuniary costs include penalties which they have to pay for non-performing loans and non-pecuniary costs are those of loss of reputation and credits for future loans.

Firm's Objective function:

$$\max_{N_t, L_t^b, \alpha_t} \sum_{s=0}^{\infty} E_t[\tilde{\beta}_{t+s}\{\pi_{t+s}^f - d_f(1 - \alpha_{t+s})\}] \tag{3.1}$$

Subject to:

$$K_t = (1 - \tau)K_{t-1} + \frac{L_t^b}{1+r_t^{b'}} \tag{3.2}$$

$$\pi_t^f = \epsilon_t F(K_t, N_t) - w_t N_t - \alpha_t L_{t-1}^b - \frac{\gamma}{2}\left((1 - \alpha_{t-1})L_{t-2}^b\right)^2 \tag{3.2}$$

$$\bar{\beta}_{t+s} = \beta^s \frac{u_{C_{t+s}}}{u_{C_t}} \tag{3.4}$$

Equation (3.2) is the law of motion for capital. Capital K_t depreciates at a rate τ and firms borrow at a price $1/1+r_t^b$ to refill their capital stock.

Equation (3.3) defines profit (π_t^f). The firms produce goods using capital

and labor as input, and ε is a total factor productivity shock. They pay a wage w_t to workers and reimburse their previous period borrowing (L_{t-1}^b). They choose what proportion α_t of their previous borrowing they want to repay, knowing that they will have to pay tomorrow a quadratic search cost on any defaulted amount. At the end have to say that firms owned by households.

3.1.2 Banks with liquidity shortage

This kind of banks holds loans L_t^b to firms, market book B_t^b,, borrowing D_t^{bd} from interbank market, D_t^b deposits from households and own funds F_t^b and with respect to the current rates they maximize profits. As for firms sector, defaulters are not excluded but have both non pecuniary and pecuniary costs (Goodhart et al. 2005).

It is noticeable that the second terms in banks maximization profit function indicate positive utility for the buffer of own funds above the minimum capital requirements imposed by the financial supervisory authority which fixes the coverage ratio of risky assets with respective of weights.

The bank with liquidity shortage maximization function is:

$$\max_{\delta_t, D_t^{bd}, L_t^b, B_t^b, F_t^b} \sum_{s=0}^{\infty} E_t\left[\tilde{\beta}_{t+s}\left\{\ln(\pi_{t+s}^b) - d_\delta(1 - \delta_{t+s}) + d_{F^b}(F_t^b - k[\bar{w}_t L_t^b + \tilde{w}B_t^b])\right\}\right] \tag{3.5}$$

Subject to:

$$F_t^b = (1 - \xi_b)F_{t-1}^b + \upsilon_b \pi_t^b \tag{3.6}$$

$$\pi_t^b = \alpha_t L_{t-1}^b + \frac{D_t^{bd}}{1 + i_t} - \delta_t D_{t-1}^{bd} - \frac{L_t^b}{1 + r_t^b} - \frac{\omega^b}{2}\left((1 - \delta_{t-1})D_{t-2}^{bd}\right)^2 +$$

$$\zeta_b(1 - \alpha_{t-1})L_{t-2}^b + \frac{D_t^b}{1 + r_t^l} - D_{t-1}^b + \rho_{t'}^b \tag{3.7}$$

Equation (3.6) states that funds are increased each period by the share υ_b of profits that are not redistributed to the households-shareholders. Furthermore, a small fixed proportion ξ_b of the own funds are put in an insurance fund managed by a public authority.

Equation (3.7) defines a period profit. The bank borrows D_t^{bd} on the interbank market at a price $1/1+i_t$. It chooses the fraction δ_t of the past borrowing it wants to pay back, knowing that it will have to pay a quadratic search cost on her defaulted amount.

Because of the existence of the insurance fund, the bank is able to recover a fraction ζ_b of the firms' defaulted amount.

3.1.3 Banks with surplus funds

This kind of banks hold: loans L_t^l to firms, market book B_t^l, lending D_t^{bs} from interbankmarket, D_t^l deposits from households and own funds F_t^l and with respect to the current rates they maximize profits.

Due to holding capital adequacy higher than supervisory standards this bank gains positive utility because of not being exposed to liquidity risk.

Since the bank with surplus fund is the only source of lending, the probability of default is indicated with negative sign.

The bank with surplus liquidity maximization function is:

$$\max_{D_t^{bs}, D_t^l, B_t^l, F_t^l} \sum_{s=0}^{\infty} E_t\left[\tilde{\beta}_{t+s}\left\{\ln\left(\pi_{t+s}^l\right) + d_{F^l}(F_t^l - k[\overline{w}D_t^{bs} + \tilde{w}B_t^l])\right\}\right] \quad (3.8)$$

Subject to:

$$F_t^l = (1 - \xi_l)F_{t-1}^l + \upsilon_l\pi_{t'}^l \qquad (3.9)$$

$$\pi_t^l = \delta_t D_{t-1}^{bs} + \frac{D_t^l}{1+r_t^l} - D_{t-1}^l - \frac{D_t^{bs}}{1+i_t} + \zeta_l(1-\delta_{t-1})D_{t-2}^{bs} + \alpha_t L_{t-1}^l -$$

$$\frac{L_t^l}{1+r_t^b} + \zeta_b(1-\alpha_{t-1})L_{t-2}^l + \varphi_{t'}^l \qquad (3.10)$$

Equation (3.9) displays the own funds dynamic. Own funds are increased each period by the share υ_l of profits that are not redistributed to the households shareholders. Furthermore, a small fixed proportion ξ_l of the own funds are put in an insurance fund managed by a public authority.

Equation (3.10) defines a bank profit. δ_t And α_t explain the portion of loan's to firms and interbank market that are not defaulted. This is important to say that, for this group of bank's there is no constraint in bank maximization profit function because there is no default for them.

3.1.4 Households

As an RBC standard models household maximizes their utility with respect to consumption and leisure. Also households try not to deviate from optimized amount of deposits.

The household's maximization function is:

$$\max_{N_t, C_t} \sum_{s=0}^{\infty} \beta^s E_t \left\{ u(C_{t+s}) + \bar{m} \ln(1 - N_{t+s}) - \frac{\chi}{2} \left(\frac{D_{t+s}^l}{1 + r_{t+s}^l} - \frac{D^l}{1 + r^l} \right)^2 \right\} \quad (3.11)$$

Subject to:

$$C_t + \frac{D_t^l}{1 + r_t^l} = w_t N_t + D_{t-1}^l + \pi_t^f + (1 - \upsilon_b)\pi_t^b + (1 - \upsilon_l)\pi_t^l \quad (3.12)$$

Hence households are the real owner of whole economy so in their budget constraint we assume firms, banks with surplus and shortage liquidity profit.

3.1.5 Central Bank (supervisory authority)

RBC Models assume that interbank market is always at Long run equilibrium although in short run the central bank may inject liquidity in market in order to restore equilibrium as well as decreasing financial shocks.

So we have:

$$M_t = D_t^{bd} - D_t^{bs} \quad (3.13)$$

Also money equilibrium follows McCallum rule:

$$M_t = \upsilon (i_t - \bar{\imath}) \quad (3.14)$$

In this equilibrium $\upsilon \geq 0$, this means when the rate of interbank market is higher than the long term equilibrium money will be injected into the interbank market[4].

In other hand if $\upsilon = 0$, there is no central bank intervention and the

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[4] since $M_t = 0$ in the long run, $\bar{\imath}$ must be equal to the equilibrium value of the interbank rate, $\bar{\imath} = i$

interbank interest rate clears the interbank market[5].

In the other hand, since the central banks oversees the activities of banks in Iran, so it determine capital adequacy (minimum capital requirements) for banks with respect to Basel regulation. It also defines the weight of assets with respect to their risks. According to guidelines of Basel 1 committee all weights are constant $\overline{\omega}_{t=\overline{\omega}}$ whereas in Basel 2 Committee the measurement of credit risk is calculated strictly in a way that if probability of default is high then it should devote higher rates to cover the risk of such loans.

$$\overline{\omega}_t = \overline{\omega} \, E_t \left[\left(\frac{\alpha}{\alpha_{t+1}} \right)^\eta \right], \text{ whereas } \eta > 0 \tag{3.15}$$

3.1.6 Oil sector

An exogenous variable, OPEC quota of oil production, is introduced in the model in an AR (1) format.

$$\log(o_t) = (1 - p_0) \log(o) + p_0 \log(o_{t-1}) + e_{ot} \tag{3.16}$$

Which "o" is stable oil production level and e_o is relative shocks that influence oil income equilibrium amounts accidently. We also assume that the entire production of oil is exported at global market price and treat the oil revenue as an exogenous variable.

3.2 Model

In solving DSGE model first, we optimize the behaviour of economic agents subject to the constraints to obtain the first order conditions. Then we analyze the amount of variable in steady state and evaluate standard deviation with respect to different shocks.

The symmetry assumption also applies to extract initial values of variables. That is; all households, firms, banks, the lender and the borrower shall make the same decisions.

It should be noted that all variables are steady state with respect to economic growth, in accordance with relationship $\widetilde{X} = x_t / \eta^t$.

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[5] Because of the long run equilibrium in the interbank market, there is no distinction between central bank money and banks money. In the other words, interest and default rate apply to both types of funds.

We will explain more about sectors first order condition in next paragraph.

3.2.1 First order conditions:

$$\varepsilon_t \tilde{F}_{N_t} = \tilde{w}_t \tag{3.17}$$

$$\varepsilon_t \tilde{F}_{K_t} = \lambda_t - E_t\big[\tilde{\beta}_{t+1}(1 - \tau)\lambda_{t+1}\big] \tag{3.18}$$

$$\frac{\lambda_t}{1+r_t^b} = E_t\big[\tilde{\beta}_{t+1}\alpha_{t+1} + \tilde{\beta}_{t+2}\gamma(1 - \alpha_{t+1})^2\tilde{L}_t^b\big] \tag{3.19}$$

$$\tilde{L}_{t-1}^b = E_t\big[\tilde{\beta}_{t+1}\gamma(1 - \alpha_t)(\tilde{L}_{t-1}^b)^2\big] + d_f \tag{3.20}$$

Equation (3.17) explain the marginal productivity of labor and wages.

Equation (3.18) also explains the marginal production of capital which is difference of today shadow prices and shadow discounted value tomorrow.

Equation (3.19) says that the shadow value of capital today is equal to its discounted expected cost.

Equation (3.20) equalizes the marginal cost of paying back today to the discounted marginal search cost of tomorrow plus the marginal disutility term.

$$\lambda_t^b D_{t-1}^{bd} = E_t\big[\tilde{\beta}_{t+1}\lambda_{t+1}^b\tilde{w}^b(1 - \delta_t)^2\big] + d_\delta \tag{3.21}$$

$$\frac{\lambda_t^b}{1+i_t} = E_t\big[\tilde{\beta}_{t+1}\lambda_{t+1}^b\delta_{t+1} + \tilde{\beta}_{t+2}\lambda_{t+2}^b\tilde{w}^b(1 - \delta_{t+1})^2D_t^{bd}\big] \tag{3.22}$$

$$\frac{\lambda_t^b}{1+r_t^b} = E_t\big[\tilde{\beta}_{t+1}\lambda_{t+1}^b\alpha_{t+1} + \zeta_b\tilde{\beta}_{t+2}(1 - \alpha_{t+1})\big] - d_{F^B}k\overline{w}_t \tag{3.23}$$

$$d_{F^b}\upsilon_b = \left(\lambda_t^b - \frac{1}{\pi_t^b}\right) - E_t\left[\tilde{\beta}_{t+1}(1 - \xi_b)\left(\lambda_{t+1}^b - \frac{1}{\pi_{t+1}^b}\right)\right] \tag{3.24}$$

Equation (3.21) is the trade-off between paying back today and paying a cost tomorrow.

Equation (3.22) and (3.23) are Euler equations respectively for borrowing

(from the interbank market) and lending (to firms).

$$\frac{\lambda_{t+1}^l}{1+r_t^l} = E_t\left[\tilde{B}_{t+1}\lambda_{t+1}^l\right] \tag{3.25}$$

$$\frac{\lambda_t^l}{1+i_t} = E_t\left[\tilde{B}_{t+1}\lambda_{t+1}^l\delta_{t+1} + \zeta_l\tilde{B}_{t+2}(1-\delta_{t+1})\right] - d_{F^l}\tilde{k}\overline{w}_t \tag{3.26}$$

$$d_{F^l}v_l = \left(\lambda_t^l - \frac{1}{\pi_t^l}\right) - E_t\left[\tilde{\beta}_{t+1}(1-\xi_l)\left(\lambda_{t+1}^l - \frac{1}{\pi_{t+1}^l}\right)\right] \tag{3.27}$$

Equation (3.25) and (3.26) are Euler equations for respective deposits (from households) and loans.

$$\frac{U_{c_t}}{1+r_t^l} = \beta E_t\left[U_{c_{t+1}}\right] - \chi\left[\frac{D_t^l}{1+r_t^l} - \frac{\overline{D}^l}{1+r^l}\right] \tag{3.28}$$

$$\frac{\overline{m}\tilde{C}_t}{1-\tilde{N}_t} = \widetilde{w}_t \tag{3.29}$$

Equation (3.28) is Euler equation for consumption augmented with the deposit target term and equation (3.29) is the labor supply first order condition.

Also all shocks in the model in equations (3.30) and (3.31) are in format AR(1) as below:

$$log\,\varepsilon_t = \rho_\varepsilon + log(\varepsilon_{t-1}) + u_t^\varepsilon \tag{3.30}$$

$$log\,\rho_t = (1-\rho_\rho)\,log\,\rho + \rho_\rho\,log(\rho_{t-1}) + u_t^\rho \tag{3.31}$$

For an empirical analysis of the model, the equilibrium values of endogenous variables directly derived from these nonlinear equations system and rewritten in terms of parameters.

Hence by calibration of parameters, all variables calculate based on primary values which this provides to solve model Dynare Software in nonlinear form.

3.2.2 Market Clearing Condition

$$F = F^b + F^l \tag{3.32}$$

$$\pi = \pi^b + \pi^l \tag{3.33}$$

$$gdp = c + \tau k + \zeta_b F^b + \zeta_l F^l \tag{3.34}$$

3.3 Calibration

We have 12 parameters as illustrated in the following table. The required ratio to the model calibration is calculated by annual data from years 1972-2016 issued by the central bank of Iran.

Table 1. Calibrated parameter values

Num	Parameters	Symbol	Data	Sources
1	Discount factor	β	0.98	Romero Villarreal (2007)
2	Capital share	μ	0.412	Shahmordi and Ebrahimi (2011)
3	Optimal ratio of capital adequacy	κ	-	Based on a scenario
4	Capital Depreciation share	τ	0.042	Shahmordi and Ebrahimi (2011)
5	Firm default cost	γ	75.4	De Walque et al. (2010)
6	Bank default cost	ω	679	De Walque et al. (2010)
7	Legal reserve	ξ	0.10	Central bank of Iran
8	Bank default Disutility	d_δ	6.67	Lawrence Christiano (2007)
9	Firm default Disutility	d_f	0.05	Lawrence Christiano (2007)
10	Deposit gap disutility	χ	0.01	Author calculations
11	Leisure utility	$\overline{m}$	1.936	Marc Hafstead and Josephine Smith (2012)

Table 2. Calibrated ratio

Num	Symbol	Data	Definition
1	$\dfrac{D^l}{L^b}$	0.96	The ratio of consumer deposit to loans to firm
2	$\dfrac{\pi^F}{F}$	0.12	The ratio of firm profit to production
3	$\dfrac{C}{F}$	0.55	The ratio of consumption to firm production
4	$\dfrac{tpcf}{F}$	0.05	The ratio of total penalty costs for banks to firms

3.4 Model Evaluation

We simulated the model By Using the parameters estimated in previous studies and with Dynare software.

In DSGE model, parameters are calibrated and used in the model. Then based on the information provided by equilibrium condition, we simulate variables through average and standard deviation.

For this purpose we demonstrate the average and standard deviation of consumption, GDP, wages, interbank rate and production variable in table No3.

Table 3. mean and standard deviation of variables

Variable Name	Mean		Standard deviation	
	Model	Data	Model	Data
Consumption	0.422	0.43	0.016	0.014
GDP	0.633	0.647	0.025	0.008
Production	0.635	1.62	0.025	1.62
Wage	2.118	2.139	0.080	0.027
Interbank Rate	0.006	0.63	0.002	0.008

Source: Author calculations

As we can see from the above table, comparing the findings of the model with the real data, indicate the relative success of the model.

Another criterion which indicates the model is well evaluated is

comparing auto correlation coefficient with simulated model variables.

Table 4: autocorrelation of variables

Variable	Data autocorrelation		Model autocorrelation	
	First order	Second order	First order	Second order
Consumption	0.989	0.971	0.928	0.948
GDP	0.968	0.936	0.917	0.785
Firm production	0.968	0.936	0.892	0.850
Wage	0.986	0.912	0.910	0.877
Interbank Rate	0.770	0.580	0.811	0.665

Source: Author calculations

The amount of auto correlation coefficient and simulated values from models results are similar to each other.

3.5 Impulse Response Function

To evaluate our model further, we analyzing impulse response function of endogenous variables to stochastic shocks.

3.5.1 Oil shock

A negative oil shock, (lower price and or lower exports) creates a liquidity shortage in interbank market which may lead to firm's default and lower profits for banks. As the interest rate increase, we may see lower investment and GDP. We can also see as a result of a drop in GDP because of the negative oil shock, wages decreasing.

In the other hand, because of a negative oil shock, in the short run taxes increases to compensate the negative effects.

Figure 3: Effects of negative oil shock
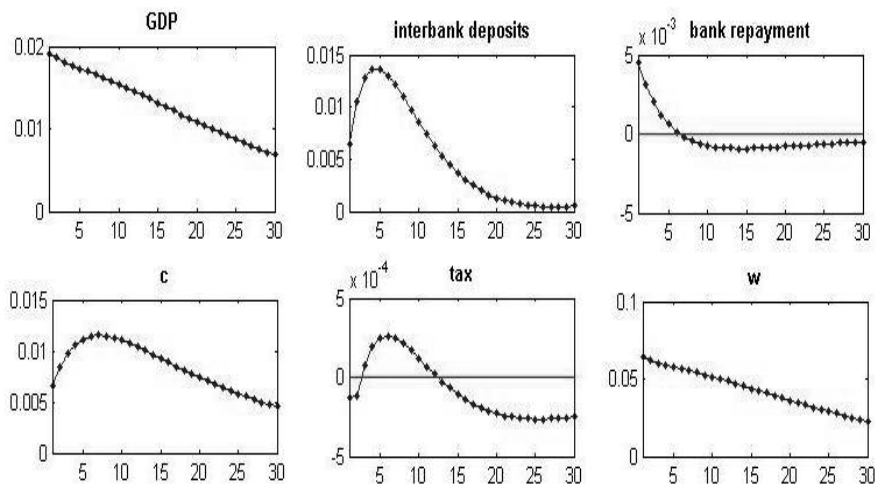
Source: Author calculations

3.5.2 Negative Market book shock and role of Central Bank

As a result of negative market book shock as we can see in the figures, interbank deposits will shrink and we will have equilibrium in a higher rate of the interbank market. In the other hand, loan's to firm reduce from bank sector and also default rate of banks and firms increases, thus GDP decreases.

In this section, we can clearly see the relation between the banking sector and real variable of the economy.

To determine the role of the central bank against negative shocks across the society, we consider a situation where the central bank injects liquidity in order to confront the negative shocks mentioned above.

As we can see in the figures, the amount of loan's to firm increases and default rate of banks and firm will be improved, so as a result in the short run, liquidity intervention by central have its own positive effects, but in the long run, liquidity interventions increase the persistence of the shock-negative- effects on economic activity.

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Figure 4: Effects of negative market book shock
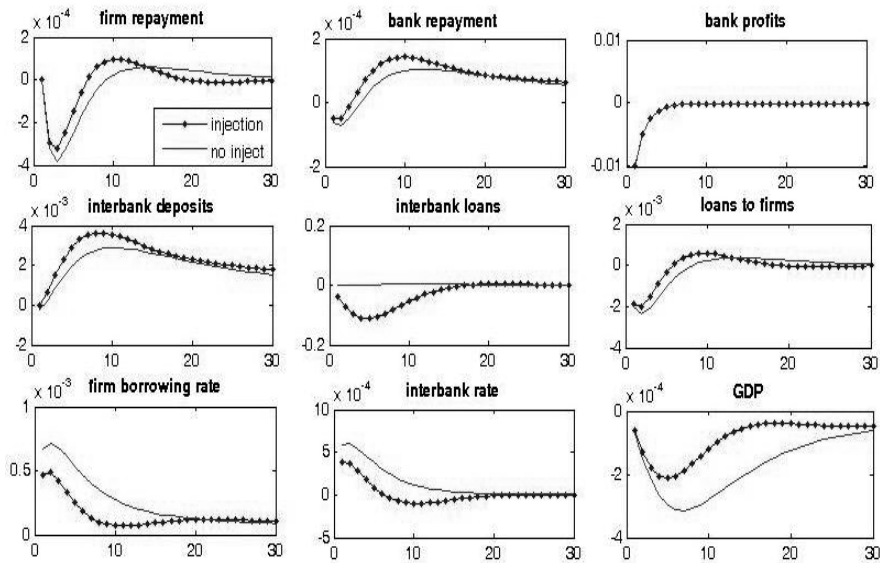
Source: Author calculations

4. Conclusions

In this paper, we introduce a dynamic stochastic general equilibrium model (related to the RBC literature) with a heterogeneous banking sector and endogenous default rate.

The purpose of this paper is to design a DSGE model for Iran (as a developing country) including a banking sector with an interbank market, and probability of loan defaults by the borrowers. We also investigate the role of central bank and importance of banking sector in reducing the impact of various exogenous and endogenous economic shocks on business cycles. A special attention has been paid to the presence of revenue from exports of oil based on allocated quota by OPEC as an exogenous variable in an AR (1) format.

Specifying the model according to the results from Comparison of the torque of the model and simulated autocorrelation variables with the real data; indicate the relative success of the model in simulating Iran's economy.

It is concluded that intermediary sector (banking sector) have an important role in transferring shocks to the economy and the Central Bank through monetary expansions can be very significant in lessening the impact of negative shocks especially in short run.

This model is relatively simple and could be extended along several directions. an extension to a New-Keynesian framework especially for developed countries would make it possible to study the effectiveness of central bank's policy to reduce inflation.

References

Allegret J.P., Benkhodja M.T. (2011), *External Shocks and Monetary policy in a Small Open Oil Exporting Economy*, University of Paris West Working Papers, No. 39.

Bernanke B.S., Gertler M., Gilchrist S. (1999), *The financial accelerator in a quantitative business cycle framework*, in J. B. Taylor, M. Woodford (ed.), Handbook of Macroeconomics, Vol. 1, Elsevier, 1341-1393.

Christiano L., Motto R., Rostagno M. (2007), *Financial Factors in Business Cycle*, European Central Bank and Northwestern University.

Dib A. (2010), *Banks, credit market frictions and business cycles*, Mimeo Bank of Canada.

DeWalque G., Pierrard O., Rouabah A. (2008), Financial (in) stability, supervision and liquidity injections: a dynamic general equilibrium approach, National Bank of Belgium Working Papers, No. 148.

Elul R. (2008), *Collateral, credit history, and the financial decelerator*, Journal of Financial Intermediation, 17, 63-88.

Gerali A., Neri S., Sessa L., Signoretti F.M. (2010), *Credit and Banking in a DSGE Model of the Euro Area, Journal of Money*, Credit and Banking, 42, 107-141.

Giri F. (2014), *Does interbank market matter for business cycle fluctuation? An estimated DSGE model with financial frictions for the euro area*, Universita Politecnica delte marche.

Goodfriend M., McCallum B.B. (2007), *Banking and interest rates in monetary policy analysis: A quantitative exploration*, Journal of Monetary Economics, 54, 1480-1507.

Goodhart C., Sunirand P., Tsomocos D. (2005), *A risk assessment model for banks*, Annals of Finance, 1(2), 197-224.

Jermann Urban J., Quadrini, V. (2009), *Macroeconomic Effects of*

Financial Shocks, NBER Working Papers, No. 15338.

Iacoviello M. (2005), House Prices, Borrowing Constraints, and Monetary Policy in the Business Cycle, American Economic Review, American Economic Association, 95(3), 739-764.

Iacoviello M., Neri S. (2011), *Housing Market Spillover: Evidence from an estimated DSGE model*, American Economic Journal: Macroeconomics, 2(2), 64-125.

Medina J., Soto C. (2005), *Oil shocks and monetary policy in an estimated DSGE model for a small open economy*, Central bank of Chile, Working Papers, No. 353.

Meh C., Moran K. (2004), *Bank capital, agency costs, and monetary policy*, Bank of Canada Working Papers, No. 6.

Markovic B. (2006), *Bank capital channels in the monetary transmission mechanism*, Bank of England Working Papers, No. 313.

Mehregan N., Daliri H. (2013), *Banks Respond to Monetary Policy Shocks Based on DSGE Model*, Journal of Economic Research and Policies, 66, 38-68.

Sargent T., Wallace N. (1981), *Some unpleasant monetarist arithmetic*, Federal Reserve Bank of Minneapolis, Quarterly Review, 1-17.

Shahhosseini S., Bahrami J. (2013), *Designing a New Keynesian Dynamic Stochastic General Equilibrium Model for Iran's Economy with Banking Sector*, Iranian Journal of Economic Research, 53, 55-84.

Shahmordi A., Ebrahimi E. (2011), *The Impacts of Monetary Policies in Iran: A DSGE Approach*, Journal of Monetary & Banking Researches, 3, 31-56.

Smets, F., Wouters R. (2007), *Shocks and Frictions in US Business Cycles*, American Economic Review, 97, 587-606.

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THE NEXUS BETWEEN TERRORISM, INVESTMENT AND GROWTH: AN ANALYSIS OF MUSLIM DEVELOPING COUNTRIES

Abstract

Terrorism has greatly influenced the economies in the world; especially the Muslim economies which were on the track for development are devastated by this global calamity. This study explores the implications of inflicted terrorism on the investment and growth of 26 Muslim countries. Feasible generalized least square (FGLS), difference generalized method of moment (DGMM) and system generalized method of moments (SGMM) approaches were used to ensure robust results. For all specifications of estimation, we have confirmed that increase in the terrorism leads to decrease in investment directly, also it lead to decrease in the marginal positive impact of growth on investment. The results indicates the public policy efforts to mitigate the loss of private investment which can be done initially by public investments to ensure public safety.

JEL CLASSIFICATION: H56, I32, K42, O15, O17.
KEYWORDS: CONFLICT, EDUCATION, MILITARY EXPENDITURES, TERRORISM.

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1. Introduction

It has been long tradition that economists search for the economic consequences of world peace and conflict. Terrorism creates a level of fear and uncertainty among people and increases the cost of doing business. It lowers output, tourism and economic growth (Keefer and Loayza 2008). In comparison to internal and external conflict, the study of terrorism in relation to economic indicators gains less attention in the literature of economics. The consciousness of human losses due to incidences of terrorism and the redirection of resources as a result of perceived risks have focused our attention towards better understanding the relationship between terrorism and economic factors.

Over the last 14 years more than 48,000 incidence of terrorism has been recorded and more than 107,000 lives were lost around the globe. Most of the terrorist attacks were experienced by Muslim's Developing Countries. However, 78% of terrorist attacks were occurred in Iraq, Afghanistan, Pakistan, Nigeria and Syria (Global Peace Index 2015). Figure 1 shows that majority of the terrorist attacks were experienced by Iraq, Afghanistan and Pakistan in last two decades. Iraq experienced more than 12,000 incidence of terrorism, While Pakistan and Afghanistan experienced more than 6,000 incidence of terrorism from 1990 to 2015. However, Algeria and turkey faced more than 2,000 terrorist attacks in last two decades. Economists such as Kai (2006), Caplan (2006) and Becker (2011) try to define the terrorism with economic reasoning after the incidence of 9/11. These authors find that terrorist activities reduce the level of output by a certain amount; due to damage of infrastructure, which occurs in result of terrorism. Increase in terrorism, retards FDI, lowers output, harms infrastructure, lessens trade and cuts economic growth. In recent study Bandyopadhyay et al. (2014) present the effect of terrorism on FDI for the panel of 78 developing countries from 1984 to 2008. They find that a significant increase in terrorism will reduce the level of FDI of host country.

Figure 1. Number of Terrorist attacks across Muslim Developing Countries from 1990 to 2015
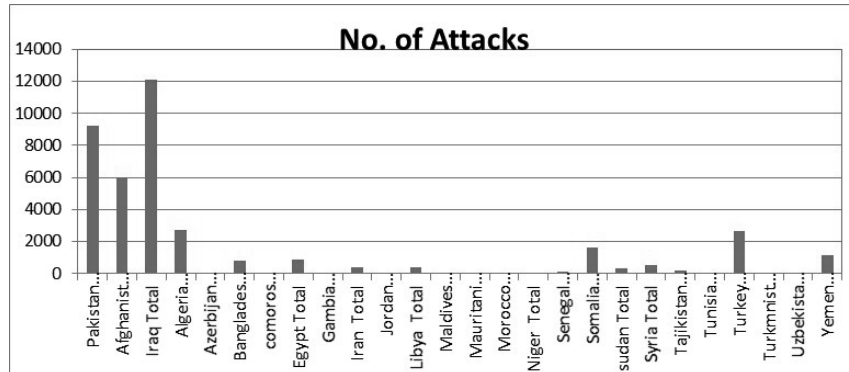
Source: Global Terrorism Database (2015)

Terrorism reduces the level of investment in country due to fear of insecurity and damage of substructure after terrorism. Moreover, foreign companies also hesitate to invest in a country pertaining high level of terrorism. Whenever, there are incidences of terrorism in any country the level of investment declines; which shows that terrorism act as a cost to investment, (Spich and Grossee 2005). In addition, Enders et al. (2006) elucidate the association between terrorism and US FDI. They use time series and panel data analysis and find that the incidence of 9/11 bring the FDI of US down. However, in panel estimation of 69 countries; they find insignificant relationship between FDI and transnational terrorism. Abadie and Gardeazabal (2008) estimate the effect of terrorism on FDI, keeping in view the panel estimation of 186 countries. Their results shows that with the increase in risk in country can reduce the FDI position by 5% of GDP because FDI is a major source of saving in order to support economic growth, especially in developing regions. Furthermore, Spich and Grossee (2005) argue that terrorism reduces the cross national trade and investment when government imposes the anti-terrorism policies. For example, the efficiency of international logistic and shipping will decrease when policies like inspection of shipping containers and security programs were introduced to protect the ports. These findings are consistent with the study of (Czinkota et al. 2004; Enders et al. 2006). However, Bouchet (2004) shows that terrorism reduces the risk taking attitude of managers. The portfolio

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managers, exporters and lenders feel fear to allocate their assets in abroad because of risk due to terrorism. The areas which are characterized by risk and volatility have less FDI and portfolio investment.

Li and Schaub (2004) argues that majority of terrorist attacks occurs in those areas which are characterized by low economic development, poverty and ungoverned spaces. Underdeveloped areas are those in which government fail to provide the basic needs, such as infrastructure or the rule of law. FDI, portfolio investment and cross country trade will reduce the terrorist activity. Sustainability of international business will reduce the poverty and other social issues in developing countries. Such policies will improve the socio economic indicators and reduce the incidence of terrorism. However, Abadie and Gardeazabal (2003) find the relationship between terrorist activity and economic impact on firm in Spain. They explain that terrorist attacks have adverse effect on the economic conditions of firm. Furthermore, Glick and Rose (2002) explain the negative relationship between trade and number of terrorist attacks. They incorporate the sample of 217 countries and include the terrorist activities from 1948 to 1997, while Enders and Hoover (2012), explain the nonlinear relationship between income and terrorism. They found that GDP per capita has strong nonlinear effect on transnational terrorism for the sample of 172 countries.

Gries et al. (2011) shows that economic growth leads to increase in terrorist activity in robust ways, In case of bivariate analysis, the relationship between terrorism and economic growth is strong while in case of trivariate specification, the impact of terrorism on economic growth diminishes. Shahbaz (2013) reveals the positive relationship between inflation economic growth and terrorism in case of Pakistan by using time series data from 1971 to 2010. Another study of Shahbaz et al. (2013) confirms the long run relationship between terrorism and economic growth by Granger causality analysis from 1971 to 2010. The result of granger causality shows that terrorism granger cause of economic growth. Shahzad et al. (2016) divides the data in two parts i.e. pre 9/11 (1988-2001) and post 9/11 (2002-2010) periods. The result provides the long run relationship between terrorism, FDI and economic growth in case of Pakistan. Granger causality reveals the bidirectional long and short run causality between FDI and economic growth in both samples. When country experiences high level of growth in industrial sector, they will experience less domestic and transnational terrorist attacks, but they disposed to more suicide attacks, (Choi 2015).

In addition, Niskanen (2006) argues that terrorism increases the military expenditures and private resources were used in order to counter the terrorism. Military expenditures were increased by $100 billion of United States from 2001 to 2005 for war against terrorism in Afghanistan and Iraq. However, the cost of US Transportation security administration is $5 billion per year for search procedures on airports. Firms have to pay additional billions of dollars annually because of risk and threat of terrorism. However, Gori (2004) shows that increase in terrorism also increase the transaction cost of international business to both defend against terrorism and comply with government mandates intended to improve the security. The above findings are consistent with the findings of Barnes and Oloruntoba (2005) and Eggers (2004).

The objective of our study is to present a dynamic panel investigation of the effect of terrorism on investment. A crucial distinction of our study is the inclusion of domestic terrorism. Domestic terrorism occurs where victims, perpetrators and targets are all from the venue countries. Such incident may deter the level of investment through political instability and high level of uncertainty. However, the effect of terrorism on investment among Muslim developing countries was meagerly studied. There are few studies such as Keefer and Loayza (2008) and Sandler and Enders (2008), which describes the relationship between terrorism and FDI in developing countries. Terrorism and their economic consequences were researched broadly in developed countries but these studies did not discuss the Muslim developing countries; which accounts the major incidence of terrorist attacks. However, this study will bridge this gap.

Our study finds a negative relationship between terrorism and investment. Keeping in view, the fully specified model, a standard deviation increase in terrorism per 100,000 persons lowers the investment/GDP by 0.194%, 0.485% and 0.835% for the case of feasible generalized least square (FGLS), difference generalized method of moments (DGMM) and system generalized method of moments (SGMM). Meanwhile, economic growth shows positive, while interest rate shows negative and significant impact on investment for the case of all base line and fully specified model by considering all three above mentioned techniques.

The study organizes as follows: section II presents the discussion on data and empirical model with econometric irregularities, while section III presents the explanation of estimated results which contribute the deeper understanding that how terrorism effects investment among Muslim's

developing countries. Section IV concludes the study with policy implication.

2. Data and Empirical model

Data regarding incidence of terrorism are obtained from global terrorism database (2015), while economic data are obtained from world development indicators (WDI 2015). The data on external and internal conflict have been extracted from global conflict risk index (GCRI 2015). The dynamic panel data model is used in order to analyze the effect of terrorism on investment of Muslim developing countries for the period of 1990-2015.

$$I_{it} = f\left(I_{i,t-1}, T_{it}, X_{it}\right) \tag{1}$$

In above mentioned model, i represent the country and t refers the time period. Investment is expressed as percentage of GDP. However, lagged Investment/GDP represents the persistence of Investment, (denoted by It-1), which is used by following studies, such as (Asiedu et al. 2009; Asiedu and Lien 2011). However, Enders et al. (2006) reveals that terrorist attacks will reduce foreign direct investment (FDI) due to disruption, damage of infrastructure and enhanced security. T denotes the number of incidence of domestic terrorism per 100,000 persons. While the X symbolizes the effect of other control variables on Investment like interaction term, growth of GDP, interest rate, exchange rate, education, trade, internal and external conflicts. Our basic regression framework is given below

$$I_{it} = \alpha + \beta T_{it} + \delta I_{t-1} + \varphi_1 IN_{it} + \varphi_2 Y_{it} + \varphi_3 i_{it} + \varphi_4 Ex_{it} + \varphi_5 E_{it} \\ + \varphi_6 TO_{it} + \varphi_7 IC_{it} + \varphi_8 EC_{it} + \varepsilon_{it} \tag{2}$$

"Y" is growth of real GDP, "i" is interest rate and "Ex" is exchange rate; which captures the expected returns on investment, (Bandyopadhyay et al. 2014). "E" is education, which represent the mix results with investment because multinational firms want to prefer operation in countries with low literacy rate, while multinational firms also require high skilled labor force and they choose country with high literacy rate (Blonigen 2005). "TO" is

trade openness[1], open economies are mostly favored by export oriented investment, (Busse and Hefeker 2007). "IC" and "EC" represents the internal conflict and external conflict. "IN" is interaction term, the interaction term is the product of terrorism per 100,000 persons and military expenditure. Military expenditure is used for the reduction in terrorism and protection of any country, which further increase the level of investment in a country, (Abu Bader et al. 2003). The internal and external conflicts are represented by an index, which is composed of civil violence, ethnic violence and civil war varies from 0-10. The higher intensity of internal and external conflict reduces the level of FDI because of higher security risk (Global report 2009). If the intensity level of conflict is 0; it represents the absence of risk in that country. The risk level from 1-4 covers the conflict, which is conducted without the use of force, while the involvement of force or several conflict actors covers the intensity of scale from 5-7 and it also considered as violent conflict. The scale from 8-10 considered as highly violent conflict depending upon the number of causalities, refugees, the personnel involved as well as the other means and consequences. Table (1), reports the result of FGLS from the cross sectional investment regression, while Table (2) and (3) explains the result of difference and system method of moment, (Global Conflict Risk Index 2015).

3. Estimation Results

We use FGLS because OLS estimators are unbiased but no longer efficient in our study due to presence of heteroskedasticity[2]. Column (1) of Table (1); represents the Investment nexus growth model from the early literature of 1990's, while column (2) and (3) introduces the effect of external and internal conflict. Column (4) and (5) represents the terrorism separately and then comprise the other forms of conflict including terrorism in order to demonstrate that how different types of conflict and terrorism effects the investment.

In Table (1); Column (1), reports the result of standard Investment nexus growth model. Economic growth has positive and significant impact on Investment for the Muslim developing countries. Trade/GDP and lagged investment is positive and significant, while the interest rate, exchange rate

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[1] Calculated by ratio of trade and GDP.

[2] We check the presence of heteroskedascity by using white test.

and education show negative and significant impact on investment. The sign of variables in column (1) is very similar to the other studies like (Syed et al. 2015, Blomberg et al. 2004) using different techniques and data sample. Column (2) and (3) shows that internal and external conflicts are positive and insignificant while rest of the control variables are negative and significant except trade/GDP and economic growth.

Column (5) of Table (1), includes terrorism and interaction term in order to check how investments effected by terrorism? The magnitude of its estimated impact shows that one standard deviation[3] increase in domestic terrorism per 100,000 persons will lead to decrease the net investment/GDP by 0.194%. If any country, whose Investment is US$100 million; the investment loss amount will be US$0.194 million for the average sample of Muslim developing country. The rest of the control variables are negative and significant except education and trade/GDP. The estimated coefficient of lagged investment/GDP is positive and significant in all columns.

The estimated coefficient of terrorism per 100,000 persons is -0.11, while the coefficient of lagged investment/GDP is 0.38. Thus, the long run effect of terrorism per 100,000 persons on investment/GDP is 0.177%. This elucidates that increase in terrorism by one standard deviation causes a reduction in investment/GDP of a country by 0.307% in the long run which is 0.11% greater as compare to short run effect, while the estimated coefficient of growth and other controlled variable is positive and significant except education and exchange rate. Conflicts and interest rate have unanticipated insignificant and positive sign, this unanticipated sign may be because of endogeneity bias in a model of FGLS.

There are two major issues related to endogeneity, first, terrorism lowers the level of output, which further reduces the level of investment. This can be eased by counterterrorism efforts of the government. Second, in national income account identity economic growth effects the investment endogenously. This raises the problem of endogeneity between terrorism, growth of GDP and investment. The conventional solution of endogeneity is to introduce the approach of instrumental variable. For multiple endogenous variables, it is difficult to find such instruments because any candidate instrument must be highly correlated with instrumented variable but uncorrelated with error term. This creates a risk of inconsistent estimate: due to possibility of correlation of unobservable panel-level effect with the

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[3] Standard deviation of terrorism is 1.74

lagged   dependent   variable   in   the   dynamic   panel   data   model,
(Bandyopadhyay et al. 2014).

Table 1. Feasible generalized square

Independent Variables	(1) Base FGLS	(2) & Internal Conflict FGLS	(3) & External Conflict FGLS	(4) & Terrorism FGLS	(5) & Terrorism, Internal conflict, External conflict FGLS
GDP growth rate	2.07*** (0.00)	2.07*** (0.00)	2.07*** (0.00)	-0.017 (0.42)	4.06*** (0.00)
Trade/GDP	10.85*** (0.00)	10.85*** (0.00)	10.85*** (0.00)	3.25*** (0.00)	15.38*** (0.00)
Interest rate	-0.342*** (0.00)	-0.34*** (0.00)	-0.34*** (0.00)	-2.64*** (0.00)	2.33*** (0.00)
***Ln*, Education (Secondary School Enrollment)**	-3.25*** (0.00)	-3.24*** (0.00)	-3.24*** (0.00)	0.14*** (0.00)	-3.99*** (0.00)
***Ln*, Exchange rate**	-5.47*** (0.00)	-5.48*** (0.00)	-5.47*** (0.00)	-6.26*** (0.00)	-4.98*** (0.00)
Investment/GDP, Lagged	0.26*** (0.00)	0.26*** (0.00)	0.26*** (0.00)	0.07*** (0.00)	0.38*** (0.00)
Internal Conflict		0.002 (0.59)			0.02** (0.00)
External Conflict			0.001 (0.76)		-0.01 (0.79)
Domestic Terrorism (Per 100,000 persons)				-0.11*** (0.00)	-0.11*** (0.01)
Domestic Terrorism ×Military expenditure/GDP				-0.23 (0.903)	1.15 (0.51)
Observation	598	598	598	366	366
R^2	0.94	0.94	0.94	0.96	0.96

P values are presented in round brackets. *; ** and *** represent statistical significance at the 0.10, 0.05 and 0.01 levels, respectively. Models (1)–(5) are different specifications of cross country investment-growth regressions. Models (1)–(4) are the basic FGLS model adding separately the different forms of conflict, i.e. terrorism, internal conflict, external conflict and their sum. However, R^2 represents the explained variation in dependent variable due to independent variable.

In view of above mentioned limitation, our study incorporate Generalized
method of moments (GMM) estimation; which is also favored by many
empirical studies like (Busse and Hefeker 2007; Asiedu et al. 2009).

However, Arellano and Bond (1991) shows that the difference generalized method of moment (known as DGMM) estimators introduce the lagged values of the first difference of endogenous variables as instrument and take the first difference of the data. The difference- GMM not only resolve the problem of endogeneity but also makes the variables stationary. After taking the difference of all variables, it takes the following form.

$$I_{it} - I_{i,t-1} = \alpha + \beta\left(T_{it} - T_{i,t-1}\right) + \delta\left(I_{i,t-1} - I_{i,t-2}\right) + \varphi\left(X_{it} - X_{i,t-1}\right) + \left(\varepsilon_{it} - \varepsilon_{i,t-1}\right) \tag{3}$$

Interest rate, lagged investment/GDP and education are negative and significant, while trade/GDP and exchange rate is positive and significant in column (1) of Table (2). The value of coefficient is -0.27

Table 2. Panel regression using DGMM

Independent Variables	(1) Base DGMM	(2) & Internal conflict DGMM	(3) & External conflict DGMM	(4) & Terrorism DGMM	(5) & Terrorism, Internal conflict, External conflict DGMM
GDP growth rate	0.17*** (0.00)	0.25*** (0.00)	0.24*** (0.00)	0.11*** (0.00)	0.12*** (0.00)
Trade/GDP	11.79*** (0.00)	12.69*** (0.00)	12.79*** (0.00)	15.87*** (0.00)	16.02*** (0.00)
Interest rate	-1.85*** (0.00)	-0.67*** (0.05)	-0.61** (0.07)	-0.05*** (0.00)	-0.07 (0.88)
***Ln*, Education (Secondary School Enrollment)**	-4.68*** (0.00)	-4.22*** (0.00)	-4.18*** (0.00)	-4.64*** (0.00)	-4.62*** (0.00)
***Ln*, Exchange rate**	0.31 (0.53)	3.28*** (0.00)	3.52*** (0.00)	2.83** (0.01)	2.64*** (0.02)
Investment/GDP, Lagged	-0.85*** (0.00)	-0.20*** (0.00)	-0.20*** (0.00)	0.09** (0.06)	0.09*** (0.05)
Internal Conflict		0.07** (0.06)			0.05 (0.23)
External Conflict			0.023 (0.67)		0.04 (0.32)
Domestic Terrorism (Per 100,000 persons)				-0.27*** (0.01)	-0.28*** (0.00)
Domestic Terrorism ×Military expenditure/GDP				-2.66 (0.69)	-3.75 (0.58)
Observation	572	546	546	217	217

P values are presented in round brackets. *; ** and *** represent statistical significance at the 0.10, 0.05 and 0.01 levels, respectively. Models (1)–(5) are the difference generalized method of moment (DGMM) for different specifications of cross country investment-growth regression.

and -0.28 for baseline and fully specified model in column (4) and (5), which confirms the decrease of 0.46% and 0.48% in the value of investment/GDP

due to a standard deviation increase in terrorism per 100,000 persons while, the rest of the variables are positive and significant except interest rate and education in both baseline4 and fully specified5 model of DGMM. The estimated coefficient of lagged investment/GDP is same for baseline and fully specified model (0.09) specifies the long run effect of domestic terrorism per 100,000 persons on Investment/ GDP are 0.29% and 0.30% for baseline and fully specified model in DGMM of column (4) and (5). A standard deviation increase in terrorism per 100,000 persons will lower the value of investment/GDP by 0.51% and 0.52% in the long run for both the models of DGM. Taking account the problem of endogeneity, Arellano and Brover (1995) elucidates that difference-GMM with lag values often act as poor instruments for the first differences. In order to resolve this problem, Blundell and Bond (1998) use the system GMM estimators, which kept in view the additional moment conditions. For each regression, study incorporates two step GMM estimators. This regression will be efficient and robust to all kind of heteroskedasticity (Asiedu and Lein 2011).

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[4] Baseline model, includes the variables of terrorism and interaction term
[5] Fully specified model, includes both types of conflicts and terrorism

Table 3. Panel regression using SGMM

Independent Variables	(1) Base SGMM	(2) & Internal conflict SGMM	(3) & External conflict SGMM	(4) & Terrorism SGMM	(5) & Terrorism, Internal conflict, External conflict SGMM
GDP growth rate	0.31*** (0.00)	0.32*** (0.00)	0.31*** (0.00)	0.30*** (0.00)	0.30*** (0.00)
Trade/GDP	13.04*** (0.00)	13.12*** (0.00)	13.15*** (0.00)	14.80*** (0.00)	15.40*** (0.00)
Interest rate	-1.69*** (0.00)	-1.69*** (0.00)	-1.68*** (0.00)	-1.01*** (0.00)	-0.92*** (0.00)
Ln, Education (Secondary School Enrollment)	-4.18*** (0.00)	-4.18*** (0.00)	-4.18*** (0.00)	-3.69*** (0.00)	-3.68*** (0.00)
Ln, Exchange rate	-0.19*** (0.00)	-0.52 (0.19)	-2.67 (0.50)	1.82*** (0.00)	1.85*** (0.00)
Investment/GDP, Lagged	-0.30*** (0.02)	-0.30*** (0.00)	-0.30** (0.00)	-0.34*** (0.00)	0.35*** (0.00)
Internal Conflict		0.10*** (0.01)			-0.08** (0.00)
External Conflict			0.03 (0.53)		0.15*** (0.00)
Domestic Terrorism (Per 100,000 persons)				-0.28*** (0.00)	-0.48*** (0.00)
Domestic Terrorism ×Military expenditure/GDP				-3.75 (0.42)	-3.15 (0.43)
Observation	598	598	598	366	366

P values are presented in round brackets. *; ** and *** represent statistical significance at the 0.10, 0.05 and 0.01 levels, respectively. Models (1)–(5) are system generalized method of moment (SGMM) for different specifications of cross country investment-growth regression

Table (3) explains the result of system GMM. In column (1) of Table (3), elucidates that all variables shows negative and significant impact on investment except growth and trade/GDP. The exchange rate is negative and significant in baseline but positive in fully specified model of system GMM. However, the rest of variables of the variables are positive and significant except interest rate and education baseline model. In conclusion of our results; Column (5) in Table (3), reports that growth, trade/GDP improves the level of investment across Muslim developing countries while, education, interest rate and internal conflicts exhibits negative and significant relationship with investment. The sign of terrorism confirms the negative relationship between terrorism per 100,000 persons and investment/GDP. A standard deviation increase in terrorism per 100,000 persons will decrease the investment/GDP from 0.835% (for fully specified model of SGMM) to 0.504% (for baseline model in column (7), of SGMM). The internal conflict shows the negative and significant impact on investment/GDP in column (10). The long run impact of terrorism per 100,000 persons on investment/GDP is 0.73% in fully specified model. It means that a standard deviation increase in terrorism per 100,000 persons will lowers investment/GDP by 1.28% in the long run.

In summary, the results of panel and cross country Muslim developing countries have common findings that terrorism and interest rate have strong negative impact on investment. It remains true while controlling the other types of conflict and endogeneity concerns. However, internal and external conflicts do shows much relationship with investment. In short, terrorism has small but negative and significant impact on total investment.

4. Concluding Remarks

Study examines the relationship between terrorism and investment/GDP for the case of 26 Muslim's developing countries; covering the period of more than two decades (1990-2015). Study applies different econometric techniques in order to ensure the robustness and consistency of our estimates. The study first utilizes the feasible generalized least square (FGLS) because OLS estimators are biased due to presence of heteroskedasticity. The result of FGLS endeavors the basic results that terrorism lowers and economic growth improves the investment. However, endogeneity problem prevails in a model because economic growth effects investment endogenously. Study applies difference generalized method of

moment (DGMM) and system generalized method of moment (SGMM) due to presence of endogeneity. A standard deviation increase in terrorism per 100,000 persons lowers the value of investment/GDP. However, GDP growth shows positive impact on investment, keeping in view all three techniques named as FGLS, DGMM and SGMM.

Furthermore, lagged value of investment/GDP shows the positive and significant relationship with terrorism per 100,000 persons, which confirms that terrorism, lowers the value of investment in long run. In addition, the effect of terrorism on investment in the long run is greater in SGMM as compare to DGMM in fully specified model. The relationship between interest rate and investment is negative and significant in all above mentioned three techniques. The increase in investment due to economic growth is greater in case of SGMM as compare to DGMM in all five models by taking economic growth as endogenous variable. Nevertheless, finding of study suggests that nature of the terrorism evolved in many ways; which cannot be detect from data. Historical evidence may not be used a good method in order to identify the consequences of terrorism in future. Our findings suggests that macroeconomic consequences of terrorism are potentially quiet significant, which confirms the prerequisite for a redoubling of public policy efforts towards examining how to best mitigate the associated risk.

References

Abadie A., Gardeazabal J. (2003), *The Economic Cost of Conflict: A Case Study of the Basque Country*, American Economic Review*, 93, 113-32.

Abadie A., Gardeazabal J. (2008), *Terrorism and World Economy*, European Economic Review*, 52, 1-27.

Abu-Bader S., Abu-Qarn A. (2003), *Government expenditures, military spending and economic growth: causality evidence from Egypt, Israel, and Syria*, Journal of Policy Modeling*, 25(6), 567-583.

Arellano M., Bover O. (1995), *Another look at the intrumental variable estimation in error component models*, Journal of Econometrics, 68, 29-51.

Arelleno M., Bond S. (1991), *Some tests for specification of panel data: Monte carlo evidence and application to employment equations*, Review of Economic Studies*, 58, 277-97.

Asiedu E., Lien D. (2011), *Democracy, foreign direct investment and natural resources*, Journal of International Economics, 84, 99-111.

Asiedu E., Jin Y., Nandwa B. (2009), *Does Foreign Fid Mitigate the Adverse Effect of Expropriation Risk on Foreign Direct Investment?*, Journal of International Economicss, 78, 268-75.

Bandyopadhyay S., Sandler T., Younas J. (2014), *Foreign Direct Investment, aid and Terrorism*, Oxford Economic Papers, 25, 25-50.

Barnes P., Oloruntoba R. (2005), *Assurance of Security in Maritime Supply Chains: Conceptual Issues of Vulnerability and Crises Management,* Journal of International Management, 11, 519-40.

Becker S.G., Rubinstein Y. (2011), *Fear and the Rrsponse to Terrorism: An Economic Analysis,* University of Chicago.

Blomberg S., Hess G., Weerapana A. (2004), *Economic Conditions and Terrorism,* European Journal of Political Economy, 20, 463-78.

Blonigen B. (2005), *A review of the empirical literature on FDI determinants,* Atlantic Economic Journal, 33, 383-403.

Blundell R., Bond S. (1998), *Initial conditions and moment restrictions in dynamic panel data models,* Journal of econometrics, 87, 115-44.

Bouchet M. (2004), *The Impact of Geopolitical Turmoil on Country Risk and Global Investment Strategy,* The Security Business Nexus, 83-104.

Busse M., Hefeker C. (2007), *Political risk, institution and foreign direct investment,* European Journal of Political Economy, 23, 397-415.

Caplan B. (2006), *Terrorism: The relevance of the rational choice model,* Public Choice, 128, 91-107.

Choi S. (2015), *Economic growth and terrorism: domestic, international and suicide,* Oxford Economic Papers, 157-181.

Czinkota M., Knight G., Liesch P. (2004), *Terrorism and International Business: Conceptual Foundation*. In G. Suder (Ed.), Terrorism and the International Business Environment, The Security Business Nexus, 43-57.

Eggers W. (2004), *Prospering in the Secure Economy*, Deloitte Research, New York.

Enders W., Hoover G. (2012), *The Nonlinear Relationship Between Terrorism and Poverty,* The American Economic Review, 102, 267-72.

Enders W., Sachsida A., Sandler T. (2006), *The Impact of Transitional Terrorism on US Foreign Direct Investment,* Political Research Quarterly, (59), 517-31.

GCRI (2015), *Global conflict risk index,* accessed from http://conflictrisk.jrc.ec.europa.eu/.

Glick R., Rose A. (2002), *Does Currency Union affects trade? A Time series Evidence,* European Economic Review, 46, 1125-51.

Global Peace Index (2015), *Measuring Peace, its Causes and its Economic Values,* Institue of Economic and Peace.

Global Report (2009), *Integrated network for societal conflict research, Center for Systemic Peace,* Vienna: data available at http://www.systemicpeace.org/.

Gori S. (2004), *The Bank Sector. In G. Suder (Ed.), Terrorism and the International Business Environment,* The Security Business Nexuses, 171-88.

Gries T., Krieger T., Meierrieks D. (2011), *Causual linkages between domestic terrorism and economic growth,* Defence peace and economics, 22(5), 493-508.

GTD (2015), *Global Terrorism Database,* accessed from https://www.start.umd.edu/gtd/.

Innes M. (2007), *Denial of Sanctuary: Understanding Terrorist safe Havens,* Westport, CN: Prager.

Kai H. (2006), *Internationaler Terrorismus In*, Informationen Zur politischen bildung, 291, 24-30.

Keefer P., Loayza N. (2008), *Terrorism, Economic Development and Political Openness,* Cambridge University Press, New York.

Li Q., Schaub D. (2004), *Economic Globalization and Transitional Terrorism,* Journal of Conflict Resolution, 48, 230-58.

Niskanen W. (2006), *The Several costs of Responding to the Threat of Terrorism,* Public Choice, 128, 351-56.

Sandler T., Enders W. (2008), *Economic Consequences of Terrorism in Developed and Developing Countries,* Cambridge University Press, New York.

Shahbaz M. (2013), *Linkages between inflation, economic growth and terrorism in Pakistan,* Economic Modelling, 32, 496-506.

Shahbaz M., Shabbir M., Malik M., Wolters M. (2013), *An analysis of a causal relationship between economic growth and terrorism in Pakistan,* Economic Modelling, 35, 21-29.

Shahzad S., Zakaria M., Rehman M., Ahmed T., Fida B. (2015), *Relationship Between FDI, Terrorism and Economic Growth in Pakistan: Pre and Post 9/11 Analysis,* Social Indicator Research, 127(1), 179-194.

Spich R., Grosse R. (2005), *How does Homeland Security affect US Firms, International Competitivenss?*, Journal of International Management, 11, 457-78.

Syed S., Saeed L., Martin R. (2015), *Causes and Incentives for Terrorism in Pakistan,* Journal of Applied Security Research, 10, 181-206.
WDI. (2015), *World Development Indicators*, World Bank.

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NEXUS BETWEEN OUTREACH AND EFFICIENCY: THE CASE OF MICROFINANCE INSTITUTIONS

Abstract

This paper attempts to empirically scrutinize the relationship between the efficiency of microfinance institutions and outreach to the poor, over the period 2000 to 2014. By using the stochastic frontier analysis the study concluded that micro finance institutions having low average loan balance are less efficient outreach to the poor. Moreover, group and all types of panels confirm the significant negative effect on efficiency. Further, gross loan portfolio and salary have a significant positive association with cost frontier. Gross loan portfolio and salary caused to increase the cost of microfinance institutions. Our dataset is significantly larger and covers a longer time period than any of the previous study in the field of microfinance and specifically focusing on sustainability; applying SFA technique for measuring the cost efficiency of MFIs, Hence, we believe this study will be a major contribution to the literature regarding the conversation about tradeoff between efficiency and outreach.

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1. Introduction

Micro finance institutions (MFls) work to facilitate the poor by providing them with credit that can help to reduce their poverty. These people have no access to the commercial banks, therefore, they try to get loans from MFIs but, this is very costly as they charged a certain amount that is most of the time not payable for the poor people who need loans to set up their own income generating businesses. The literature in this paper will focus on the general outreach of the loan offered by MFIs. Some NGO and western donors are supporting MFIs by offering them loans at low interest rates so that MFIs can help to the poor by providing them these loans appropriate low interest rate. These loans also sourced to small the companies.

Now, the attention seems to be shifted from subsidizing MFIs to making them financially stable and efficient to reduction the cost of lending. The importance is being laid on reduction the cost of lending money that will be generated after the loan is transferred. Developments in microfinance institutions have encouraged competitions among MFIs, as a result, the expansion of their services, fetched technological changes, financial liberalization and regulation of polices which made by the government (Rhyne & Otero, 2006).

Environments are shaped in which provision of loans and access of these loans for everybody made convenient & easier. Compatible objectives introduced that will certainly contribute in making MFIs resourceful and improve its stability. Financial sustainability of MFIs is significantly imperative which could help to provide loans to more people and enlarge the amount of loans. Moreover, the commercialization of microfinance support to increase commercial funds and transmitting of these funds for commercial purpose. Implications of financial market policies that focusing on strengthen the market forces and stability progression ensure the access of poor people to the MFIs. Not only this, it also support to the outreach aim of MFIs, consequently, generating more financial resources.

Lending of the money is therefore not easier as financial sustainability is compatible or the struggle of outreach become debatable and hinders for the reach of a common man. The issues must be investigated in the light of studies being conducted earlier or those studies which were piloted on that

phenomenon but unfortunately many new studies are presented and investigated on that issue in an unsystematic way, most studies have also provided with anecdotal evidences and used either short data sets or plain analysis except for Cull, Dimirgic-Kunt, and Murdoch(2007).

This research study is based on two aims; first is the investigation on the potential compatibility between efficiency of MFIs and their outreach. To analyze this, a detailed dataset will be studied that contains information collected for a large number of MFIs over a longer period of time. The studies done previously in this field were not in detailed at all. Secondly, different measures of sustainability would be used focusing by applying different statistical techniques that have not been used before, these are at extensively rich, such as SFA which stands for stochastic frontier analysis. SFA will help us to measure the efficiency of MFI, s and furthermore assist us to find the outreach status of MFI, s. Data from 2000-2014 obtained from mix market will be used which will cover approximately 467 MFIs.

The literature (section 2) of the paper will discuss the relationship between financial sustainability; outreach and efficiency of MFIs .Section 3 of the paper will explain SFA through research methodology, whereas, section 4 continues with dataset. Section 5 will show the discussion of estimation and section 6 will brief the main research and will conclude what has been derived from analysis.

2. Review of Literature

New challenges faced by MFIs have affected them in doing their businesses, the basic reason of which; is the competition between MFIs that has increased rapidly (Rhyne & Otero, 2006). Reasons for this competition hype; when some of the MFIs started offering low interest rates and costs. Those MFI, s tried to be more efficient and introduced new financial services of saving account and insurance services. One of the countries that have experienced an increase in the competition since 1990s, in the microfinance industry is Bolivia. Bolivian MFIs lower down the interest rates from 30% in 1998 to 21% in 2005.In addition to this, it increased its range of financial services making it better and more convenient for its clients (Ryne & Otero, 2006).

Though there are developments being done to improve the efficiency and sustainability of MFIs, still the amount of transaction for lesser loans is more as compared to the larger ones. These transaction costs include, screening, administration costs and monitoring for each loan (Conning 1999; Hulme & Mosley , 1996; Lapenu & Zelley 2002; Paxton & Cuevas , 2002) . Hence, a trade-off between efficiency and outreach is lowering down the goals of many MFIs which needs to provide money to the poor. There has been long debates on the issue of tradeoff between efficiency and outreach among the welfare entities whom put forward the idea of dominance of outreach objective (Hashimi & Rosenberg, 2006; Montgomery & Weiss, 2005: Woller, 2002).Some of scholars, (Christen, 2001:Isern & Porteus,2005; Ryne,1998) also stressed upon the significance of efficiency and sustainability. Both camps have different point of views however, they have somehow on the same common conclusion; i.e. under specific conditions, sustainability and outreach may be compatible (Morduch, 2005).

Schreiner M. (1999) concluded study in which the agreement of microfinance institutions and welfare of poor were not relatively matched to achieve the expected objectives. Likewise; author proposed an agenda for outreach and microfinance social advantages in the shape of six facets, such as; depth, breadth, length, scope, worth and cost. That phenomenon incorporated the both aspects properly, approach of self-sustainability and poverty tactic to microfinance. On the one hand, poverty approach shoulder that high profundity of outreach could reimburse for slender extent, tiny length and restricted scope. On the other hand, approach of self-sustainability pleasantly presumed that breadth at wide level, extensive length, and abundant scope could reward for trivial depth.

Ledgerwood, J. 1998 described in the handbook, fetch composed in a solitary source, supervisory doctrines and tools which will endorse viable microfinance and craft worthwhile institutions. It offers an inclusive foundation for the scheme, execution, assessment, and administration of microfinance undertakings. Author fundamentally concentrated on viability of microfinance institutions to ripe the results.

This competition among MFIs has stimulated the commercial banks to initiate their own micro financing schemes as past history has shown that the commercial banks brought success and profitable businesses whereas, in some countries, the government has stimulated the commercial banks to

initiate microfinance schemes. K-REP in Kenya and the commercial bank of Zimbabwe are a good example of these. All these moves have pressured the MFIs to lower their interest rates and costs to increase their efficiency. New banking technology such as ATM , use of cell phones and the internet has been involved in the business of MFIs to help make the delivery of services better (Kapoor, Ravi &Murdoch, 2007; Rhyne and Otero; 2006). Mc Intosh, De Janvry and Sadoulet (2005) concentrated on increasing effects of the competition among the MFIs. In this research studies which conducted by them, they evaluated that the poor are not able to benefit more from MFIs and on the other hand; the number of borrowers who are wealthier benefitted from these loans exceedingly. They claimed that the outreach is severely hurt by the pressure of competition that has built up on the MFIs. The real purpose of launching MFIs has been lessened and therefore it has deviated from the policies which used to follow for movement. On the other hand, Gonzalez Rosenberg (2006) suggested that nothing seems to be against each other, neither the financial sustainability nor the outreach.

Developing countries have taken a few productive measurements in liberalizing financial markets that will help to stabilize the microfinance business. Change in policies will sustain the efficiency of microfinance and their progression (Hartarska and Nadolynak, 2007). MFIs are now being supported by various banks and investors, especially the bank from developing countries are launching microfinance divisions, supporting activities of microfinance industry. City group,   Deutsche Bank, HSBC are even involved in it. These commitments, in some way also helps these financial institutions to show their CSR (corporate social responsibility). The banks have their interest due to ' double bottom line' as they call it, providing attractive risk return profiles (Deutsche Bank Research 2007). The first capitalization of MFIs with the creation of an investment fund called Profound in 1995. It almost collected $ 23 million to support Latin American MFIs. In the year 2006 MIV's (microfinance investment vehicle) held MFIs shares portfolio that was of $2.3 billion (CGAF, 2007). The need of MFIs has increased with increasing curiosity for commercial banks making them sustainable, financially stable and efficient.

Surprisingly in few studies, we found some careful investigations studied by Cull et al. (2007) which were founded to be the most appropriate. The authors investigated 124 MFIs in 49 countries using measures of profitability

and outreach; then compared to one another. His new and extensive study suggested that MFIs focus more on group clients that are wealthier as compared to poor male and female clients .Targeting wealthier individuals as borrowers is called" mission drift" which is not as strong for the group based MFIs. Therefore, Cull et al. (2007) did find out the evidence that showed a trade-off between efficiency and outreach. It was noted that the MFIs are gaining good profits focus on providing loans to individuals. Various measures were used, the loan size was considered to be the depth and the numbers of borrowers were regarded as the breadth. Calculating them, strong evidence was found for a trade-off between sustainability, outreach and efficiency. Using loan size as depth and number of borrowers as breadth of the outreach, authentic proofs were founded for the trade –off between sustainability, outreach and efficiency. They presented this theory by viewing the data of 2,600 MFIs in 2004. Though it seems to be correct but since the data was based on self-reports, therefore it won't be appropriate to regard it as accurate or near to accurate (Cull et al., 2009).

Keeping the factual studies in our mind, we can clearly state that the evidences found are less and not sufficient enough to prove the compatibility or trade-off in terms of sustainability and outreach. Most the analysis made in a simple way. A few recent studies by Qayyum and Ahmad (2006) showed that not looking at the undermined elements involved and just focusing on the efficiency, the MFIs can easily achieve their goal. They put forward this theory after measuring the efficiency of 19 MFIs in the three South Asian Countries. According to Cull et al. (2007), the observational study by him are important in the terms that the datasets used are large and contains the data that has been collected extensively considering many MFIs. To find out about the cost function, we will use the SFA (Scholastic Frontier Analysis).The focus will be more on the cost efficiency but not on the profit efficiency. The final aim of the MFIs is to decrease poverty. MFI, s can only achieve this goal if their emphasis will be more on the cost efficiency.

3. Methodology

In our annotations, cost efficiency of an MFI is measured as how adjacent the real cost of loaning to the best practice MFI ,if both are giving alike output under identical circumstances. Cost efficiency refers to the lowest

cost of lending of an MFI if it is apparently and theoretically efficient. Since the functions of cost cannot be experimented directly, therefore, efficient cost frontier is used to calculate inefficiency of cost. Data envelopment analysis (DEA) and stochastic frontier analysis (SFA) are techniques used to measure the efficiency of cost. Aigner et al (1977) developed the SFA model techniques in a formulation format, that was based on an equation shaped as:

$$y = \beta'x + v - u \qquad (a)$$

In eq. (a) the model originally originated where y=pragmatic outcomes and the other part of equation $\beta'x + v - u$, considered as optimum frontier objective. $\beta'x$ is the fixing fragment of the frontier as well as $v \sim N[0,\sigma 2v]$ is the stochastic slice. We are inclined to use SFA model as it is liable to control the measurement errors and other casual effects.

The study incorporated the model developed by Aigner et al (1977); Sealey and Lindley (1977); Kumbhakar and Knox Lovell (2000), to elaborate the cost function. They affirm that a financial institution works as a midway amid lenders and debtors. We considered Interest expense on deposit per unit and labor cost per unit as Input prices of MFI, whereas output of MFI is calculated by gross loan collection of MFI. We standardized the cost function by taking natural logarithm.

The model is as follows

$$\ln COST_{i,t} = a_0 + b_1 \ln(SLRY_{i,t}) + b_2 \ln(I_{i,t}) + b_3 \ln(GL_{i,t}) + d_1 \ln(SLRY_{i,t})^2$$
$$+ d_2 \ln(I_{i,t})^2 + d_3 \ln(GL_{i,t})^2 + g_1 \ln(SLRY_{i,t})x\ln(I_{i,t}) + g_2 \ln(SLRY_{i,t})x\ln(GL_{i,t})$$
$$+ g_3 \ln(I_{i,t})x\ln(GL_{i,t}) + j_1 YEAR_t + j_2 YEAR_t^2 + j_3 YEAR_t(SLRY_{i,t}) + j_4 YEAR_t(I_{i,t})$$
$$+ \mathring{a}_{k=5}^{8} j_k MFITYPE_{i,t} + c_1 EA_{i,t} + c_2 LL_{i,t} + m_{i,t} + u_{i,t} \qquad (1)$$

In Eq. (1) total cost is represents by COST, SLRY shows the cost of labor per year. I present the interest expense on deposit per unit. Whereas, GL is the portfolio of gross loan for MFIs, MFITYPE interpret the types of MFIs. COST is calculated by adding up the aggregate overheads of an MFI; SLRY is incorporated as total operating cost per worker of MFI; I is the measurement of MFI's aggregate monetary cost per dollar of

credits; and GL is incorporated as gross loan assortment of an MFI. The function of cost consist of input and output variables individually, mixtures of these variables, and the square of these variables. All variables balance per borrower (in US dollars). We also take YEAR (a year dummy), which runs from 1 to 15, the square of the year dummy, and its connections with the input variables to account for expertise changes over time.

(MFITYPE), a vector of dummies is added to control the cost function that varies in different types of MFIs. Subsidies obtained by these institutions at different levels are main cause of difference in cost between types of MFIs. We need to add a control variable for MFIs type, as our data do not offer thorough information regarding expected subsidies. We use variables dummy for non-banking financial institutions (NBFI), banks (BANK), rural banks (RLBANK), cooperatives (CO), non-governmental organizations (NGO), and other organizations (OTHER). The variable OTHER is skipped from analysis for the motives of individuality.

We also include some other control variables. First, to measure the level of risks in different MFIs we incorporate (EA), equity to total assets proposed by, Grigorian and Manole (2006), Lozano-Vivas, Pastor, and Hasan (2001) Dietsch and Lozano-Vivas (2000), and Berger and De Young (1997).As risk taking strategies are different among MFIs, to control this factor, we add (LLR); loan loss reserves (Fries & Taci, 2005; Lensink, Meesters, & Naaborg, 2008).

As mentioned earlier, the significant purpose of this paper is to examine the relationship between efficiency and outreach of microfinance institutions. In our framework *mi,t* used to measure the inefficiency of microfinance business. To investigate the association between efficiency and outreach we identify a model, in which inefficiency is a dependent variable and for outreach, we have a lot of measures. In addition, a number of control variables that may influence the inefficiency are also included.

The inefficiency equation is as follows:

$$m_{i,t} = a_0 + a_1 ALB_{i,t} + a_2 WOM_{i,t} + a_{j=3,4,5,6} LT_{i,t} + a_7 AGE_{i,t} \tag{2}$$

In above equation m is the first driver of inefficiency of MFI I at time t. MFI is likely to be inefficient if this movement is higher. ALB and WOM are the measures of outreach that are generally accepted. If the value of

ALB is higher, the depth of outreach will be lesser, which means MFI is estimated to offer rarer loans to poor clients. WOM is the fraction of female clients in the aggregate loan portfolio of a MFI. Higher value of WOM shows more depth of outreach, because lending to female clients is linked with lending to poor clients.

We concede that our procedures are possibly provide irregular estimates of outreach. Because these only wrap-up one portion or measurement, that is, the depth of outreach. As Schreiner (2002) discussed, outreach have a number of magnitudes, i.e. Importance of MFI loan for borrower, the cost of loan to borrower, breadth, length and scope of outreach, and most of these are hard to measure. This is the reason why we use a huge data-set of MFI in this paper. Paxton (2003) discussed that size of loan is associated with loan type or, it can be correlated with lending policy of MFI. MFIs which focus on activities related to agriculture need bigger loan size on average, this is the reason that MFIs which focus on activities related to trade and services have better outreach than others. However, by considering the data limitations we can conclude that using large dataset, average loan size, and loan to female clients are clearly the finest methods we can use, as these methods are also used in many other studies.

Before giving our remarks related to trade-off between efficiency and outreach, we again stress that dependent variable in Eqn. (2) calculate the point where an MFI is inefficient. It means we expect coefficient for WOM is significantly positive, while the coefficient for ALB is significantly negative. The other variables used in Eqn. (2) are control variables. LT is a dummy variable representing the category of loans an MFI primarily provides. Inefficiency of microfinance business depends upon the kind of loans it mostly provides. We use four different dummy variables demonstrating that the microfinance institutions primarily offers village loans (VILLAGE), individual loans (IL), group loans (GROUP), and individual, village, and group loans (ALLTYPE).Those Institutes which are not incorporated in any of the above dummy variables are those MFI which do not make civic their primarily loan type. AGE is the number of years an MFI establish. This variable helps to examine the hypothesis that older microfinance institutions are more efficient. An alternative hypothesis is that, newly build MFIs are more efficient than older because, they learn from their knowledge and established more

efficiently. The acceptance of first hypothesis is indicating that AGE is statistically significant and negative. While in second case, AGE is significant and positive**.**

4. Data

The microfinance data is collected from Mix Market database, a well-known source of microfinance institutions. We filter the data on such conditions: (1) the MFIs without last three years data are eliminated from the dataset. (2) Those MFIs stopped working with the selected time period are also eliminated. After filtering the MFIs, the data consists of 467 MFIs with the time period of 15 years (2000-2014).

Table 1. Number of MFIs

Year	No of MFIs
2000	34
2001	63
2002	119
2003	183
2004	237
2005	289
2006	291
2007	13
2008	32
2009	48
2010	106
2011	96
2012	183
2013	198
2014	203
Total	**2095**

Table 2. Region wise MFIs

Region	Individual	Mixed	Solidarity	Village	Total
South Asia	6	38	9	11	64
Africa	27	86	49	2	164
East Asia and the Pacific	46	41	3	1	91
Latin America and the Caribbean	93	21	2	1	117
Eastern Europe and Central Asia	11	13	4	3	31
Total	**183**	**199**	**67**	**18**	**467**

Table 1 displays the number of MIFs per year used for econometric analysis. Table 2 shows the type of loans given to different regions of country; individual, mixed, solidarity, village loans. For the case of South Asia, Africa and Eastern Europe, mixed lending is higher than other kind of landings. Whereas, East Asia & Pacific, Latin America & Caribbean are mostly focus on the individuals for lending.

Descriptive statistics are given in table 3; the findings indicate that MFIs focus on individuals with mean value of 1,135. The mean value of mixed lending is at number second with 563. The mean value of village is 81, which indicating that the least focus of MFIs is in villages. Moreover, the statistics of percentage loans below US$300, percentage WOM borrowing, Average savings balance per saver (US$) and percentage clients in bottom half of the population are given in table 3.

Table 3. Descriptive statistics

	Individual	Mixed	Group	Village	Total
Average loan balance per borrower					
Mean	1,135	563	119	81	719
St. dev.	909	797	41	43	863
Obs	211	254	71	18	554
% loans below US$300					
Mean	51	63	97	92	79
St. dev.	23	38	16	6	23
Obs	34	51	19	17	121
% WOM borrowers					
Mean	47	69	61	93	53
St. dev.	28	21	24	5	22
Obs	146	171	84	19	420
Average savings balance per saver (US$)					
Mean	1,896	2,339	30	27	1,755
St. dev.	10,413	26,401	69	36	18,419
Obs	184	197	69	23	431
% clients in bottom half of the population					
Mean	16	11	0.3	54	14
St. dev.	18	9	-	0.7	18
Obs	7	26	4	7	44

5. Estimating Strategy and Results

Outcome of the relationship between outreach and efficiency is incorporated in table 4.Estimated results are produced by using the following procedure. As it is stated earlier that SFA (stochastic frontier analysis) uninterruptedly evaluates the inefficiency and cost frontier. Specification of Eqn. (1) excluding (columns [1–3]), including the Year dummy and input variables (columns [4–8]) are used for the Estimations of cost.

Table 4. Estimation results

				Panel A – The cost frontier				
SLRY	1.981***	2.119***	2.112***	2.026***	2.129***	2.121***	2.131***	2.016***
I	-0.147**	-0.100	-0.241***	-0.135*	-0.022	-0.193**	-0.180**	-0.198**
GL	0.697***	0.662***	0.642***	0.694***	0.679***	0.621***	0.676***	0.711***
SLRY * I	0.018**	0.019	0.021***	0.010*	0.002	0.029***	0.025**	0.027**
I * GL	0.05	0.004	0.009	0.09	0.007	0.006	0.009	0.001
SLRY - GL	-0.023***	-0.028***	-0.011**	-0.020***	-0.021***	-0.012*	-0.013**	-0.04
SALARY2	-0.069***	-0.089***	-0.088***	-0.077***	-0.082***	-0.081***	-0.081***	-0.087***
GLP2	0.011***	0.018***	0.017***	0.016***	0.011***	0.019***	0.010***	0.002**
R2	0.008	0.007	0.007	0.007	0.008	0.007	0.007	0.007
BANK	-0.455***	-0.306*	-0.477***	-0.408***	-0.211	-0.402***	-0.377**	-0.387**
CO	-1.003***	-0.896***	-1.009***	-0.947***	-0.797***	-0.927***	-0.919***	-0.959***
NBFI	-0.701***	-0.516***	-0.736***	-0.657***	-0.411**	-0.653***	-0.623***	-0.649***
NGO	-0.709***	-0.471**	-0.759***	-0.659***	-0.349*	-0.661***	-0.661***	-0.700***
RLBANK	-0.956***	-0.845***	-0.988***	-0.881***	-0.719***	-0.899***	-0.901***	-0.989***
LL	2.581***	2.533***	2.409***	2.601***	2.469***	2.397***	2.341***	2.341***
EA	-0.391***	-0.242***	-0.342***	-0.392***	-0.251***	-0.347***	-0.287***	-0.294***
YEAR				-0.199***	-0.201**	-0.163**	-0.153**	-0.139*
YEAR2				0.003***	0.004***	0.003***	0.004***	0.003***
SLRY-YEAR				0.002	0.005	0.005	0.005	0.002
I - YEAR				0.005	-0.005	-0.002	-0.002	-0.003
Constant	-8.419***	-8.039***	-8.789***	-7.801***	-7.162***	-8.099***	-8.483***	-8.201***
Obs.	1,304	1,061	1,061	1,304	1,061	1,061	1,061	1,061

As it is stated above, specification of cost frontier is not our major emphasis; rather it is the specification of inefficiency equations and particularly the tradeoff between efficiency and outreach. In inefficiency equation (2) specific to general method is followed (Brooks, 2002). This permits us a thorough examination of the effects of trade-off between efficiency and outreach with regard to diverse specifications of inefficiency equation. Examination of inefficiency equation is started by individually considering the two of Outreach variables in it. Then we take into account both of these variables of outreach together into one regression. Columns [1–6] Panel B of Table 5 is incorporated with the results of these three different specifications. The results of cost function are incorporated in columns [1–3] not including the year dummy variables. The result of three different specifications of cost frontier is presented in columns [4–6] after including the year dummy variables. Our analysis is mainly based on these six different specifications.

Table 5. Estimations

Panel B – The inefficiency equation								
ALB	-0.211***		-0.181***	-0.217***		-0.185***	-0.189***	-0.195***
WOM		0.409***	0.145**		0.519	0.131**	0.146**	0.134**
INDIVIDUAL							0.076	0.079
GROUP							⁻0.202***	-0.190***
VILLAGE							0.049	0.3
ALLTYPE							-0.081*	-0.070*
AGE								0.002***
Constant	2.043***	0.120	1.918***	2.011***	-0.478	1.947***	2.009***	1.899***
Obs.	1,304	1,061	1,061	1,304	1,061	1,061	1,061	1,061

In columns [7-8], diverse groups of control variable is added in relation with three different specifications of cost frontier presented in columns [4–6]. As our data set is in group form so, our all estimated results are incorporated after using pooled regressions. Estimation outcomes of cost frontier are presented in panel A of table 4. In most cases of cost function the estimation results   are appears to be same as expected: the coefficients of

GL and SLRY   are positive and significant. The coefficient of I is contrary to our expectation and is negative. As many of quadratic terms and interactions are positive and significant so it's really hard to immediately monitor the minimal effect of I on total cost. Marginal Average minimal effect of I on total cost is calculated by using so-called delta method, which tells us that minimal effect is positive and significant. After critically analyzing we can wrap-up that our estimated results are in line with previous literature. All risk taking variables I.e. LL, EA, and all dummy variables used in this study related to MFI type are statistically significant for all specifications presented in table 4 that shows cost frontier is affected by type of MFI and risk taking policy.

The coefficient of year dummy is provided in columns [4–8], which is significant and shows that total cost is concentrated with time; we can say it is the results of some technical change. This can be described as learning curve effect: due to the world-wide expansion of MFI business, sharing technology and knowledge are making people more capable under the supervision of MFI.

The estimated results of efficiency and outreach to poor are presented in columns [1–6] of table 5 of panel B. The results show there is a tradeoff between these two. Estimated results for the coefficient of ALB are unconstructive and statistically significant. The results show that those MFIs who focus more on lending to poor are less efficient. Since the coefficient of WOM is statistically significant and constructive in most of the cases, so we can conclude that those MFIs are less efficient which focusing to provide loans for female borrower. The estimated results for the variables of outreach do not change even after the inclusion of control variables. Estimated results for coefficient for ALB are negative and statistically significant and it is unchanged for all the specifications in columns [7] and [8].

The estimated results for WOM are also unchanged in all different specifications. Estimated results of control variables presented in panel B of Table 5 is as follows. Firstly Loan type dummy variable is incorporated in the analysis, Columns [7-8] shows there is a statistically significant and negative coefficient for ALLTYPE and GROUP variables. It shows those MFIs which focus on combine lending, group lending, village lending and

individual lending are more proficient. Particularly the estimated results related to GROUP are really charming.

The above discussion postulate that as information cost is less in group lending so; it is cheaper than individual lending. These results are also been studies in a paper on the determining factor of cost efficiency of Microfinance institution (Caudill et al., 2009).Column [8] shows the coefficient of AGE is statistically significant and positive which mean newer MFIs are more efficient than older. Our estimated results are in line with the past literature and show that more lately reputable MFI gain profit from the information with sanction of microfinance practices, built-up throughout the past decades. As we have some missing values in our data for few MFIs, to avoid this situation that our estimated results are influenced by this, we apply the models in which use at least five year observations. Author robust his estimated results for these subsamples. The coefficient of ALB still remains highly significant and negative, while coefficient of WOM remains highly significant and positive.

Shortening the consequences in Table 4, we find that in our sample there is a tradeoff between efficiency and outreach .Even after the addition of control variables, our estimated results remains the same. Our estimated results are in line with the findings of Cull et al. (2007), who did experimental analysis on the relationship between efficiency and outreach. Cull et al. (2007) suggest MFIs which are more profitable have less female clients and poor borrowers. Moreover, as they gradually grow to be larger, they have more affluent clients, which show "mission drift."

Our dataset is significantly larger and covers a longer time period than any of the previous study in the field of microfinance. Furthermore our measures for sustainability are different than any of the previous studies; specifically we apply recent technique, SFA while measuring the cost efficiency of MFIs. Therefore, we believe this study will be a major contribution to the literature regarding the conversation about tradeoff between efficiency and outreach.

5. Conclusion

This paper has found out the trade–off between efficiency of MFIs and outreach to the poor through the methodology of SFA. A sample of more

than 1300 observations was estimated and investigated, which provided evidences showing a negative relationship between the efficiency of MFIs and the outreach to poor. Investigation also showed that the lower the amount of the loan given by MFIs, which is considered as the depth, the lower is the efficiency to transfer the funds. Similarly the efficiency of MFIs is also low where the clients are women. The results were carried out thoroughly having added different controlled variables. The MFIs being commercialized are not of much help to the real targeted audience; that is, the poor. But on the other hand, commercialization has provided them reasons to be more efficient and alert in their field. Though they have become more efficient but the focus is less on the outreach of poor as it was before. But the results of the investigations do not gives the idea that MFIs being more efficient and concentrating less on poor is bad. Zeller and Johannsen (2006) stated that the score of MFIs being low on outreach to poor may in a way cause higher poverty reduction but more at a macro level. So, it can be assumed that MFIs are helpful in making the economic conditions better in the society, especially at the regional and country level.

Efficient MFIs are playing a better role in the society than the ones which focus more on the outreach, ignoring the efficiency factor. The factual and observational studies so far have shown the effects of MFIs on both the regional and country level. But the evidences collected to view the results are not enough and more detailed readings must be noted to come up with more authentic results. The issue still needs more research so, it can be examined more carefully and so better results can be derived from the data that will be collected through some other individual countries or regions. The behavioral aspects of microfinance could be more focused in future so, the governmental decisions and policies proposes to get the basic aim of MFI, s to provide loans to poor for their betterment. The future implication of research not generalized some other regions in the same style for policy making but it could be helpful employing some other statistical techniques for research studies then results could be more interesting and as predictable.

References

Aigner D., Knox Lovell C.A., Schmidt P. (1977), *Formulation and Estimation of Stochastic Frontier Production Function Models*, Journal of Econometrics 6(1), 21-37.

Battese G.E., Coelli, T.J. (1995), *A model for technical inefficiency effects in a stochastic frontier production function for panel data*, Empirical Economics*, 20(2), 325-332.

Berger A.N., De Young R. (1997), *Problem loans and cost efficiency in commercial banks*, Journal of Banking and Finance, 21(6), 849-870.

Brooks C. (2002), *Introductory econometrics for finance*, Cambridge University Press, Cambridge.

Caudill S.B., Gropper D.M., Hartarska V. (2009), *Which microfinance institutions are becoming more cost-effective with time: Evidence from a mixture model*, Journal of Money, Credit and Banking*, 41(4), 651-672.

AP C.G. (2007), *CGAP Brief*, CGAP (April), Washington DC.

Christen R.P. (2001), *Commercialization and mission drift: The transformation of microfinance in Latin America*, Occasional paper No. 5, Washington DC: CGAP.

Conning J. (1999), *Outreach, sustainability and leverage in monitored and peer-monitored lending*, Journal of Development Economics, 60(1)*, 51-77.

Cull R., Demirgig-Kunt A., Morduch J. (2007), *Financial performance and outreach: A global analysis of lending micro banks*, The Economic Journal, 117(1), F107-F133.

Cull R., Demirgiig-Kunt A., Morduch J. (2009), *Microfinance meets the market*, Journal of Economic Perspectiv*es, 23(1), 167-192.

Dietsch M., Lozano-Vivas A. (2000), *How the environment determines banking efficiency: A comparison between French and Spanish banks*, Journal of Banking and Finance, 24(6), 985-1004.

Fries S., Taci A. (2005), *Cost efficiency of banks in transition: Evidence from 289 banks in 15 post-communist countries*, Journal of Banking and Finance, 29(1)*, 55-81.

Grigorian D.A., Manole V. (2006), *Determinants of Commercial Bank Performance in Transition: An Application of Data Envelopment Analysis*, Comparative Economic Studies, 48(3), 497-522.

Gonzalez A., Rosenberg R. (2006), *The state of microfinance: Outreach, profitability and poverty*, Presentation at the World Bank conference on access to finance.

Hartarska V., Nadolnyak D. (2007), *Do regulated microfinance institutions achieve better sustainability and outreach? Cross-country evidence*, Applied Economics, 39(10), 1207-1222.

Hashemi S., Rosenberg R. (2006), *Graduating the poor into microfinance: Linking safety nets and financial services*, Focus note No. 34, Washington, DC: CGAP.

Hulme D., Mosley P. (2006), *Finance against poverty*, Volumes 1 and 2, Routledge, London.

Isern J., Porteous D. (2005), *Commercial banks and microfinance: Evolving models of success*, Focus Note No. 28, CGAP, Washington DC.

Kapoor M., Ravi S., Morduch J. (2007), *From microfinance to m-finance. Innovations: Technology, Governance*, Globalization, 2(1-2), 82-90.

Kumbhakar S.C., Knox Lovell C.A. (2000), *Stochastic Frontier Analysis*, Cambridge University Press, Cambridge (MA).

Lapenu C., Zeller M. (2002), *Distribution, growth, and performance of the microfinance institutions in Africa, Asia and Latin America: A recent inventory*, Savings and Development, 26(1), 87-111.

Ledgerwood J. (1999), *Microfinance Hand Book: Institutional and financial Perspective*, The World Bank, Washington DC.

Lensink R., Meesters A., Naaborg I. (2008), *Bank efficiency and foreign ownership: Do good institutions matter?*, Journal of Banking and Finance, 32(5), 834-844.

Lozano-Vivas A., Pastor J.T., Hasan I. (2001), *European bank performance beyond country borders: What really matters?*, European Finance Review, 5(1-2), 141-165.

Makame A.H., Murinde V. (2006), *Empirical findings on cognitive dissonance around microfinance outreach and sustainability*, Unpublished paper, University of Birmingham, Birmingham.

Matousek R., Taci A. (2004), *Banking efficiency in transition economies: Empirical evidence from the Czech Republic*, Economics of Planning, 37(3-4), 225-244.

McIntosh C., De Janvry A., Sadoulet E. (2005), *How competition among microfinance institutions affects incumbent lenders*, The Economic Journal, 115(506), 987-1004.

MixMarket (2007), <www.mixmarket.org>. visited October. MIX Microbanking Bulletin, Trend Lines 2003-2005 MFI Benchmarks.

Morduch J. (2005), *Smart subsidies for sustainable microfinance*. Finance for the Poor: ADB Quarterly Newsletter of the Focal.

Paxton J. (2003), *A poverty outreach index and its application to microfinance*, Economics Bulletin, 9(2), 1-10.

Paxton J., Cuevas C. (2002), *Outreach and sustainability of member-based rural financial intermediaries*, in M. Zeller, & R. L. Meyer (Eds.), *The triangle of microfinance. Financial sustainability, outreach, and impact.* Johns Hopkins University Press, Baltimore and London.

Qayyum A., Ahmad M. (2006), *Efficiency and sustainability of microfinance institutions in South Asia*, Pakistan Institute of Development Economics (PIDE), Islamabad.

Research Deutsche Bank (2007), *Microfinance. An emerging investment opportunity*, Frankfurt am Main: Deutsche Bank.

Rhyne E. (1998), *The yin and yang of microfinance: Reaching the poor and financial sustainability*, Microfinance Bulletin, July, 6-8.

Rhyne E., Otero E. (2006), *Microfinance through the next decade: Visioning the who, what where, when and how.* Paper commissioned by the Global Microcredit Summit 2006, ACCION International, Boston, MA.

Schreiner M. (2002), *Aspects of Outreach: A Framework for Discussion of the Social Benefits of Microfinance*, Journal of International Development, 14(5), 591-603.

Sealey C.W. Jr., Lindley J.T. (1977), *Inputs, outputs, and a theory of production and cost at depository financial institutions*, Journal of Finance, 32(4), 1251-1266.

Woller G. (2002), *The promise and peril of microfinance commercialization*, Small Enterprise Journal, 13(4), 12-21.

Zeller M., Johannsen J. (2006), *Is there a difference in poverty outreach by type of microfinance institution? The case of Peru and Bangladesh*, Paper presented at the global conference on Access to Finance: Building Inclusive Financial Systems, organized as part of the annual conference series of The World Bank and the Brookings Institution in Washington, DC, May 30 and 31.

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RELATION BETWEEN RENEWABLE ENERGY AND UNEMPLOYMENT IN NON-OECD COUNTRIES. "AN ECONOMETRIC ANALYSIS BASED ON THE STUDY OF 11 NON-OECD COUNTRIES"

Abstract

Using a PANEL OLS MODEL, this study evidences the dynamic relationship between the production of renewable energy such as hydroelectric, biomass, wind, solar, geothermal, and the unemployment that was considered as the dependent variable in the 11 non- OECD Countries,over the period 1990-2014.

The paper identifies conditions in which renewable energy contribute to a reduction of unemployment in non-OECD Countries. In Particular this evidence is clear not for all renewable energy but only for Biomass and Solar Power . The explanation for this result is given by the morphology of the non-OECD Regions, and by high skill transferability in renewable energy sector. This result is very interesting, because shows that in developing countries where unemployment is very high, the government could intervene with policies for the increase of renewable energy for the reduction of unemployment.

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1. Introduction

This paper analyzes the macroeconomic effects of renewable energies production on socio-economic variables which contribute to improvement of life in non-OECD countries. In particular, among the economic socioeconomic variables analyzed, the unemployment rate was considered as a driver of a lifestyle improvement, in fact it is assumed that a decrease in unemployment corresponds to an improvement in the lifestyle of the population. This paper assumes that if Governments and businesses from various non-OECD countries are starting to invest in Renewable Energy, they will gain economic improvements, in particular it is assumed that investments in renewable energy have a significant impact on reducing the unemployment rate. It has already been shown that exploitation of renewable energies contributes to a reduction in CO_2 emissions, catalyzing a worsening of a country's health and hence a worsening country's economic status. It is proven that in the 11 dimensions of well-being there is quality and quantity of work.

The OECD has outlined the 11 Dimensions of Wellness. One of these, is the availability and quality of work. These are essential for the welfare of the people and can have a very important impact on the material and non-material conditions of life.Having a job is a source of pride and dignity in fact, helps the creation of personal identity. Being unemployed, have a negatively effects on physical and mental health. This suggests that the negative effects of unemployment go well beyond the loss of income and endure over time. The long-term unemployment leads to the loss of skills and additional employment opportunities and exposes people to the risk of social exclusion and poverty.If the job greatly reduces the risk of poverty, does not necessarily remove this risk, because poor families composed of people who work there are significantly in all non-OECD Countries.

The total number of unemployed in the world in 2015 was estimated at 197.1 million, 27 million more than in pre-crisis level of 2007. The amount for 2015 is expected to undergo an increase of about 2.3 million in 2017 and reach the 205.4 million. A large number of workers are having to accept low-paying jobs, not only in emerging economies and developing, but increasingly also in industrialized countries. Although it decreased the number of unemployed in some European Union (EU) and the United States, are always too many people still out of work. In industrialized countries, the unemployment rate fell from 7.1 percent in 2014 to 6.7 per cent in 2015. In

many cases, however, these improvements were not sufficient to eliminate the employment gap caused by the global financial crisis. In addition, the employment prospects have deteriorated now also in emerging and developing, particularly in Brazil, China and the oil-producing countries. The unstable economic environment, the volatility of capital flows, financial markets still mal-functioning and weak global demand, continue to weigh on business and discourage investment and the creation of jobs, "says Raymond Torres, Director of the Department the ILO research. They are 156 million (or 37.7 percent of the total of the reference group) young people who work but live in poverty. These data confirm that poverty affects more young workers and adult (26 percent of working adults living in poverty).

Figure 1 - Global Unemployment Trends
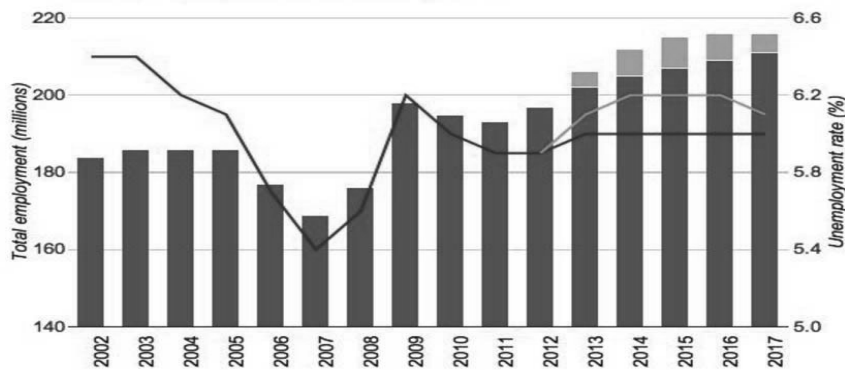
Source: International Labour Organization (2013' Report)

Table 1 - Youth unemployment and young working poor: trends and forecasts until 2017

	2015	2016	2017	
World	12,9	13,1	13,1	
Developed countries	15	14,5	14,3	
Emerging countries	13,3	13,6	13,7	
Developing countries	9,4	9,5	9,4	

Source: World Employment and Social Outlook 2016: Trends for Youth.

In the second section of this paper, we have defined the research objectives, providing a contribution to existing literature, analyzing the positive relationship between renewable energies and unemployment. The third section shows an analysis of the literature, pointing out that in the past some researchers focused mainly on the relationship between energy and GDP, while only some researchers have focused on the analysis of the relationship between renewable energies and GDP and very few On the existing relationship with the unemployment rate.

2. Research goals

In recent decades they have made good efforts to ensure access to electricity in all countries. The governments of all countries have promoted important electricity grid development programs and support mechanisms to facilitate the diversification of energy sources and has also supported the off-grid production by RES plants in areas where it is more difficult to get the network electricity. A careful national energy planning, characterized by a long-term time horizon, favored the progress of the energy sector and new investments. Unfortunately non-OECD Countries are, the less respectful of environmental regulations, the purpose of this publication is to show that the OECD Countries would agree to not convert their conception of energy passing to a greater use of renewable energies which can 'allow not only improvements in pollution reduction but also in terms of employment.

**Figure 2 - Evolution of global investment in renewable energy
(2004-2012)**

Source : "Global Trends In Renewable Energy Investment 2013" Frankfurt School-UNEP
Centre/BNEF

The main purpose of this paper is to study the relationship between
renewable energy and economic growth. In particular, between
unemployment and renewable energy. This study investigate the dynamic
relationship between the production of renewable energy such as
hydroelectric, biomass, wind, solar, geothermal, and the unemployment that
was considered as the dependent variable in the 11 non- OECDCountries
over the period 1990-2014.

3. Literature review

There are many studies related on connection between energy
consumption and economy, for example (Sari, Ewing, and Soytas, 2008;
Fowowe, 2012; Mercan and Karakaya, 2015; Khatun and Ahamad, 2015;
Sharma (2010); Carley, Lawrence, Brown, Nourafshan, and Benami, 2011;

Ramos and Veiga, 2014; Ozturk, 2010; Payne, 2010. In this line of study, there is a clear correlation between economic growth and energy prices. Unfortunately, the studies on renewable energies are not satisfactory especially there are not enough studies that analyze the relationship between renewable energy and jobs or unemployment. Unfortunately, especially in developing countries, they have gone through a period of continued unemployment due to the huge global crisis, the inefficiency of the labor market. Therefore it is crucial to focus on the relationship between energy and work, and especially for renewable energies since footprint was found that would reduce pollution but it is not established that can reduce unemployment. Most studies was based on the analysis of this relationship through the use of the method of the coefficient at fixed or variable effects. Hillebrand for example in 2006 create an analysis with which it has attempted to identify, through the use of input-output model, a relationship between the two variables. His study, analyzing Germany came to the conclusion that favorable policies in a development of alternative energies, can make a positive contribution to employment in the short term, but negative in the medium to long term. Lehrer, conducted a study, for the Germany, he concludes that this relationship between the two variables is positive, especially for a long time a high unemployment rate. Ragwitz in 2009 using the European Union, as a sample studied,was considering variables related to policies aimed at supporting the development of alternative energies. He identified a positive relationship between energy policies and employment.Bohringer, analyzing Canada, tried to identify a relationship with the cost of energy policies. Kuster differing from previous authors in 2007 has examined the impact of investments in alternative energy in the European Union, on economic variables such as unemployment. The conclusion was that the renewable energy sources are added to the unemployment rate. Bovenberg and Mooij , examined the relationship between taxation to environmental policies and employment, they tried to explore the effects of the displacement of the cost of polluting goods on employment and the non-environmental welfare. They found that the increase in costs related to the movement of polluting goods results in an increase in unemployment. Scholz, Bovenberg and Van Der Ploeg, in 1998 and in 1996, analyzed variables that indicate the change in unemployment considering the effect of factors such as the elasticity of tax rates and other factors. In 2009Payne investigates causality between renewable and non-renewable energy consumption and employment using time series data for

the period of 1976-2006 in Illinoi. He reveals a unidirectional causality from energy consumption to employment. In 2011 Menegakiusing a panel causality test European countries over the period 1997-2007, finds a bidirectional causality between renewable energy and employment. Apergis and Payne in 2015 examines the causality between renewable and non-renewable energy consumption and unemployment using panel data of Latin America, Europe, Asia and Africa. They revealed a unidirectional causality from renewable energy consumption to unemployment across all regions, as long as the recent time period is approached.

4. Methodology

In this study we sought to answer the following question:
-   Is there a relationship between renewable energy and unemployment?
-   Will Renewable energy contribute to development of non-OECD countries?

The methodology adopted for this study followed the following steps:
-   creation of a 1 panel with 11 non-OECD countries a bow time goes from 1990 to 2013.
-   Dependent Variable: Unemployment.
-   Independents Variables: Economics Variables and Renewable EnergyProductions Variables.

For this panel is been adopted the following methodologies to analyze the relationships between the dependent variables and independent variables :
-   A - Creation of the regression curve for the variables with OLS Method (Augmented Dickey-Fuller).

In statistics, ordinary least squares (OLS) or linear least squares is a method for estimating the unknown parameters in a linear regression model, with the goal of minimizing the sum of the squares of the differences between the observed responses (values of the variable being predicted) in the given dataset and those predicted by a linear function of a set of explanatory variables. Visually this is seen as the sum of the squared vertical distances between each data point in the set and the corresponding point on the regression line – the smaller the differences, the better the model fits the data. The resulting estimator can be expressed by a simple formula, especially in the case of a single regressor on the right-hand side. The OLS estimator is consistent when the regressors are exogenous, and optimal in the class of linear unbiased estimators when the errors are homoscedastic and

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serially uncorrelated. Under these conditions, the method of OLS provides minimum-variance mean-unbiased estimation when the errors have finite variances. Under the additional assumption that the errors are normally distributed, OLS is the maximum likelihood estimator. In the case of a model with p explanatory variables, the OLS regression model writes:

$$Y = \beta_0 + \sum_{j=1\ldots p} \beta_0 X_j + \varepsilon$$

where Y is the dependent variable, β_0, is the intercept of the model, X_j corresponds to the jth explanatory variable of the model (j= 1 to p), and e is the random error with expectation 0 and variance σ^2. In the case where there are n observations, the estimation of the predicted value of the dependent variable Y for the ith observation is given by:

$$y_i = \beta_0 + \sum_{j=1\ldots p} \beta_{j0} X_{ij} + \varepsilon$$

The OLS method corresponds to minimizing the sum of square differences between the observed and predicted values. This minimization leads to the following estimators of the parameters of the model:

$$\beta = (X'DX)\text{-}1 \; X' \; Dy \; \sigma^2 = 1/(W - p^*) \; \Sigma_{i=1..n} \; w_i(y_i - y_i)$$

where β is the vector of the estimators of the β_i parameters, X is the matrix of the explanatory variables preceded by a vector of 1s, y is the vector of the n observed values of the dependent variable, p^* is the number of explanatory variables to which we add 1 if the intercept is not fixed, w_i is the weight of the it h observation, and W is the sum of the w_i weights, and D is a matrix with the w_i weights on its diagonal.

4.1. Data set Analysis

The analysis covered a sample of eleven NON OECD nations, the sample used is very homogeneous and linear. The non-OECD nations selected are the following: Argentina, Bolivia, Brazil, China, Chile *, Cuba, Ecuador, Egypt, Guatemala, India, Indonesia.

The dataset constructed combines different sources. For the energy sector, it be collected data on energy balances from the publications of IEA (International Energy Agency), data that contains annual data on final energy consumption for the whole economy and for major sectors such as industry, commerce and public services, transport and residential sectors. All information on the economic performance in the different sectors is taken datasets from the World Bank World Development Indicators (WDI), from IEA(International Energy Agency) Statistic Database (Energy Balance of non-OECD Countries), from World Energy Council (Energy Efficiency Indicators database), from IRENA (International Renewable Energy Agency) database, from REN 21(renewable energy policy network)

4.2. Variables

For the creation of the Panel, we used energy variables and economic variables. The dependent variable used, is the Unemployment Rate . While, as independent variables, have been chosen energy type variables , related to the production of renewable energies, to highlight that whit an increase of renewable energies production, can be depend a reduction of unemployment. Renewable energy variables studied and included in the panel are the follows: Hydroelectric which is synthesized by the acronym HDP, solar energy which is synthesized by the acronym SEP, the energy derived from biomass synthesized by the acronym BMP, and wind energy synthesized with the acronym SEP. In addition, we chose to analyze the existence or not of a dependence on the result of GDP growth and Investments synthesized with the acronym FDI, therefore the most recent economic variables were included among independent variables.

Table 2 - Variables List

VARIABLE	TYPE	UNITS' OF MEASUREMENT	ACRONYM	SOURCE
Unemployment	Economic		UNM	WorldBank ILO estimate
Direct Investment	Economic	MillionDollar	FDI	WorldBank
GDP	Economic	MillionDollar	GDP	WorldBank
Net of Wind Energy Production	Energy	Billion Kilowatt hours	WEP	Eia
Net of Solar Energy Production	Energy	Billion Kilowatt hours	SEP	Eia
Biomass Electric Power	Energy	Billion Kilowatt hour	BMP	Eia
Hydroelectric Power	Energy	Billion Kilowatt hour	HDP	Eia

5. Results

The Panel, gave satisfactory results, in fact, showed no missing observations. Thanks to model Panel, the degrees of freedom ($N * T$) observations increased which, thus allowed the estimation of further observations.

The macroeconomic results of the OLS model used are summarized in table number three. The panel analyzed consists of 259 observations with a length of the time series that ranges from a minimum of 21 to a maximum of 24. As mentioned earlier, the Dependent variable chosen for the creation of the model is the unemployment rate because we want to see how the independent variables chosen react with unemployment. The time period used is from 1990 to 2014. The data used were mostly homogeneous, highlighting the existence of a linear correlation between the variables. The result of linearity obtained is as follows LM: 128 881 with a p-value P (Chi-square (6)> 128 881) = 2.21165e-025.

Table 3 - OLS Method results (1990-2014)

	coefficient	std.error	t-ratio	p-value	
const.	2161+06	446746	4.839	2.27e-06	***
HDP (Hydroelectric)	66568.6	6443.95	10.33	4.34e-021	***
SEP (Solar)	−528448	1.6496+06	−0.3203	0.7490	*
GDP	5501-06	1.814-06	3.033	0.0027	***
BMP (Biomass)	−1.025+06	93230.1	−11.00	3.08e-023	***
WEP (Wind)	111547	111754	0.9981	0.3192	
FDI (Direct Investment)	−0.000103	3,43E+00	−3.007	0.0029	***

R-squared	0.662013

The table shows the specifications of orders and deterministic part of the OLS model through various analyzes that are more suitable results to pursue the object of study, in particular for tracked observations. It can easily notice that already in the OLS model is a clear inverse relationship between the variable UNEMPLOYMENT and variables BMP and SEP.

The result of this research can be considered very positive, in fact we have obtained very low p-value for all variables with a R-squared high. This confirms the existence of a relationship between energy and economic growth in a country. What distinguishes this research from the literature is that, using a quantitative econometric approach, energy variables and, in particular, variables of renewable energies and economic socio-economic variables, such as unemployment and GDP, have been correlated with a sample Referring to non-OECD countries, countries that have always been affected by inadequate energy policies. In particular, the clear evidence of the inverse relationship between unemployment and GDP confirms that policies conducive to the exploitation of renewable energies can increase socio-economic benefits, in fact through the exploitation of renewable energy, we see a reduction in unemployment. Numerically we see SEP with a coefficient of -528448 and BMP with a coefficient of -1.025 + 06.

Figure 4 - Trend of Variables
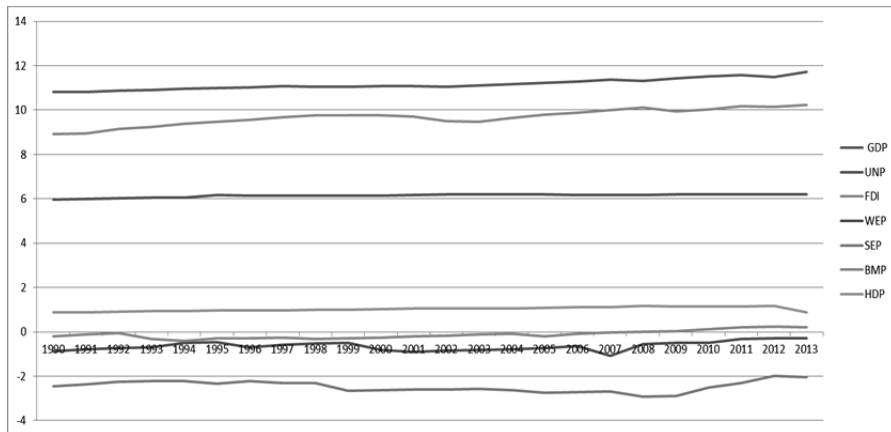
Source: result of econometric analysis

From this graph it became clear that to have an inverse relationship to the unemployment factor are biomass and geothermal. For another the result of these factors is very important fact:
- BMP (Biomass): Coefficient − 1,025+06 with ***
- SEP (Solar Energy Production): Coefficient −528448 with *

While all other variables (Hydroelectric, Geothermal and Wind) have a positive value and then means they have a direct relationship.

Furthermore, is important the direct relationship between GDP and Unemployment, because it evidence that there isn't' an positive impact between Renewable Energy Variables, and Unemployment.

6. Conclusions

Energy has always played a key role in the development and competitiveness of a Nation, depending on the strategic decisions of Economic subjects such as: Increasing productivity, economic growth, Sustainable Development, Unemployment Rate, Energy investments, energy supply choices and exploitation choices may also depend on the availability of resources and raw materials, regardless of their renewable or fossil nature.With this work we want to prove how production increasing and use

of alternative energies could have a positive impact on the economic growth and the reduction of unemployment.

This research focuses on socio-political aspects(effects of renewable energy on unemployment) related to the energy sector over a 25-year period in non-OECD developing countries such as Argentina, Bolivia, Brazil, China, Chile, Cuba, Ecuador, Egypt, Guatemala, India and Indonesia. In the processed data panel, we have related, as a dependent variable, the level of unemployment, while as independent variables, energy and economic ones, to study the impact they have on the economic growth of non-OECD countries.

The literature shows that the increase in unemployment mainly depends on economic variables such as GDP.In this research, the effects of GDP have been isolated withan OLS analysis that shows a direct relationship between the variation in GDP and the unemployment rate,in this way we have been able to isolate the effects of these ones by giving greater importance to energy variables.

The consequence of this from the OLS model is that there is a relevant significance on all the energy variables such as hydroelectric***, solar*, biomass *** and wind, in particular it is inferred that there is one Reverse relationship between Unemployment and Solar Energy and Biomass.This last result is demonstrated by the fact that for both energy sources, considered as chain and working sub-sectors, also have effects on the level of unemployment, particularly on medium skilled workers. GDP does not affect unemployment, as the variation in GDP has had a significant impact mainly on capital intensive sectors, but investment change has a positive impact on unemployment.

Concluding, it is possible to confirm that renewable energy from biomass and solar energy creates indirect and induced effects that have a positive effect on the NON-OECD countries' economies, and in particular contribute to the reduction of unemployment. Given the result of this work and pointing out that the Biomass and the Solar sectors have a positive effect on the unemployment rate, the indication of Policy on the countries involved calls out for a strengthening of investments in these sectors as each investment in this imply a Reduction of Unemployment.

References

Abosedra S., Baghestani H. (1989), *New evidence on the causal*

relationship between U.S. energy consumption and gross national product, The Journal of Energy Development, 14(2), 285-292.

Aqeel A., Butt M.S. (2001), *The Relationship between Energy Consumption and Economic Growth in Pakistan*, Asia-Pacific Development Journal, 8(2), 101-110.

Asafu-Adjaye J. (2000), *The relationship between energy consumption, energy prices and economic growth: time series evidence from Asian developing countries*, Energy Economics, 22(6), 615-625.

Chontanawat J. (2013), *Modelling the Causal Relationship between Energy Consumption and Economic Growth in Asia*, University of Technology, Thonburi.

Chontanawat J., Hunt L.C., Pierse R. (2006), *Causality between Energy Consumption and GDP: Evidence from 30 OECD and 78 Non-OECD Countries*, Surrey Energy Economics, Discussion paper Series, 113, Centre (SEEC), School of Economics, University of Surrey.

Dantama Y.U., Abdullahi Y.Z., Inuwa N. (2012), *Energy consumption - Economic growth nexus in Nigeria: An empirical assessment based on ARDL bound test approach*, European Scientific Journal, 8(12), 185-189.

Di Maria C., Valente S. (2006), *The direction of technicalchange in capital-resource economies*, EconomicsWorkingPaper Series 06/50, ETH Zurich.

Dickey D., Fuller W. (1979), *Distribution of the estimators for autoregressive time series with a unit root*, Journal of the American Statistical Association, 74(366), 427-431.

Economic Consulting Associates (2014), *Correlation and causation between energy development and economic growth*, Department for International Development.

Engle R.F., Granger C.W.J. (1987), *Cointegration and Error Correction: representation, estimation and testing*, Econometrica, 55(2), 251-276.

Fatai K., Oxley L., Scrimgeour F.G. (2004), *Modelling the causal relationship between energy consumption and GDP in New Zealand, Australia, India, Indonesia, Philippines and Thailand*, Mathematics and Computers in Simulation, 64(3), 431-445.

Ferguson R., Wilkinson W., Hill R. (2000), *Electricity use and economic development*, Energy Policy, 28(13), 923-934.

Gbadebo O.O., Okonkwo C. (2009), *Does energy consumption contribute to Economic Performance ? Empirical Evidence from Nigeria*, Journal of economics and international finance, 1(2), 44-58.

Granger C.W.J. (1969), *Investigating Causal Relations by Econometric Models and Cross-Spectral Methods*, Econometrica, 37(3), 424-438.

Granger C.W.J., (1988), *Causality, Cointegration and control*, Journal of Economic Dynamics and Control, 12(2-3), 551-559.

Hill R.C., Griffiths E.W., Lim G.C. (2008), *Principles of Econometrics*, Wiley, New York.

Im K.S., Persaran M.H., Shin Y. (2003), *Testing for unit roots in heterogeneous panels*, Journal of Econometrics, 115(1), 53-74.

Jenner S., Chan G., Frankenberger R., Gabel M. (2010), *What Drives States to Support Renewable Energy?*, The Energy Journal , 33(2), 1-12.

Johansen S., Juselius K. (1990), *Maximum likelihood estimation and inference on cointegration with applications to the demand for money*, Oxford Bulletin of Economics and Statistics, (52(2), 169-210.

Jumbe C. (2004), *Cointegration and Causality between Electricity Consumption and GDP: Empirical Evidence from Malawi*, Energy Economics, 26(1), 61-68.

Kraft J., Kraft A. (1978), *On the relationship between energy and GNP*. The Journal of Energy and Development, 3(2), 401-403.

Lee C.C. (2005), *Energy consumption and GDP in developing countries: A Cointegrated panel analysis*, Energy Economics, 27(3), 415-427.

Lee C.C. (2006), *The causality relationship between energy consumption and GDP in G-11 countries revisited*, Energy Policy, 34(9), 1086-1093.

Loschel A. (2002), *Technological change in economic models of environmental policy: a survey*, Ecological economics, 43(2), 105-126.

Maddala G.S., Wu S. (1999), *A comparative study of unit root tests with panel data and a new simple test*, Oxford Bulletin of Economics and Statistics, 61(S1), 631-652.

Mihajlović B. (2011), *Alternative Energy sources as an important factor of Serbia's economic development*, Megatrend Review, 8(1), 147-166.

Nielsen S.B., Pedersen L.H., Sorensen P.B. (1995), *Environmental policy, pollution, unemployment, and endogenous growth*, International Tax and Public Finance, 2(2), 185-205.

Razzaqi S., Sherbaz S. (2011), *Dynamic relationship between energy and economic growth: evidence from D8 Countries*, The Pakistan Development Review, 50, 437-458.

Salim R., Rafiq S., Hassan K. (2008), *Causality and Dynamics of Energy Consumption and Output: Evidence from non-OECD Asian Countries*, Journal of Economic Development, 33(2), 1-26.

Schneider K. (1997), *Involuntary unemployment and environmental policy: the double dividend hypothesis*, The Scandinavian Journal of Economics 99(1), 45-59.

Shiu A., Lam P.L. (2004), *Electricity Consumption and Economic Growth in China*, Energy Policy, 32(1), 47-54.

Stern D.I., Enflo K. (2013), *Causality between Energy and Output in the Long-Run*, Energy Economics, 39, 135-146.

Toda H.Y., Yamamoto T. (1995), *Statistical inference in vector autoregressions with possibly integrated processes*, Journal of Econometrics, 66(1), 225-250.

Vlahinic-Dizdarevic N., Zikovic S. (2010), *The Role of Energy in Economic Growth: The Case of Croatia*, Journal of Economics and Business, 28(1), 35-60.

Westerlund J., Edgerton D.L. (2008), *A Simple Test for Cointegration in Dependent Panels with Structural Breaks*, Oxford Bulletin of Economics and Statistics, 70(5), 665-704.

Yamusa II S.U., Ansari A.H. (2013), *Renewable Energy Development in Two Selected African Countries: An Overview and Assessment*, Renewable Energy L. & Pol'y Rev., 151.

Yoo S.H. (2006), *The Causal Relationship between Electricity Consumption and Economic Growth in the ASEAN Countries*, Energy Policy, 34(18), 3573-3582.

Yu E., Choi J.Y. (1985), *The Causal Relationship between Energy and GNP: An International Comparison*, The Journal of Energy and Development, 10(2), 249-272.

Yu E.S.H., Hwang B.K. (1984), *The Relationship between Energy and GNP: Further Results*, Energy Economics, 6(3), 186-190.