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The Editorial Board, *Economic Review: Occasional Paper* (ISSN 1608-6627), has the pleasure of releasing this 23rd issue of the Review on the occasion of the 56th Anniversary of the Nepal Rastra Bank (NRB). This issue incorporates analytical articles from the staff of the NRB and an academician outside the NRB on contemporary issues of the economy.

Though the articles are reviewed by the Editorial Board, the Board does not guarantee the accuracy of the data and analytical results along with their implications. Moreover, the views and interpretations included in the articles are those of the authors and do not necessarily reflect and represent the views and policies of the NRB.

The Editorial Board would like to thank Mr. Shyam Raj Tripathee, Assistant Director and Mr. Sanu Bhai Maharjan, Supervisor (Computer), Research Department both in the Publication Section for their valuable assistance in the publication of this issue.

The Editorial Board invites applications of quantitative, econometric, and analytical tools and techniques as developed by the authors of the articles to draw on conclusions and suggestions to be most useful to the readers. Those interested in contributing analytical articles to the *Economic Review* on pertinent subject of the economy such as money, banking and finance, trade and balance of payments, government finance, broad-based and sustained economic growth, socio-economic development, etc. are requested to submit the articles for consideration in the forthcoming issues.

Any comments, queries, suggestions, and correspondence should be directed to the Editorial Board.

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Harnessing Remittances for Productive Use in Nepal

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Abstract

Remittances contribute largely to the national economy. The remittances sent home by the migrants affect development at both the household and national levels. At the household level, remittances help to reduce poverty, improve standard of living and attain higher educational levels. At the macro level, remittances could be used for entrepreneurship and productive investment which in turn increases job opportunities and income of the people. At the same time, remittance inflows help to augment foreign exchange reserves and improve the current account position. This paper suggests that workable policies and programs need to be developed by Nepal's policy makers for encouraging the utilization of remittances for productive use in order to promote longer-term growth.

I. BACKGROUND

Since the end of the 1990s, there has been a renewed interest in the financial resources that migrants send back to their countries of origin. The main reason for the renewed attention is the growing volume of official remittances to low income countries and their potential contribution to the economic development of the receiving regions.

According to IMF (2009: 272), remittances denote "household income from foreign economies arising mainly from the temporary or permanent movement of people to those economies. Remittances include cash and noncash items that flow through formal channels, such as via electronic wire, or through informal channels, such as money or goods carried across borders. They largely consist of funds and noncash times sent or given by individuals who have migrated to a new economy and become residents there, and the net compensation of border, seasonal, or other short-term workers who are employed in an economy in which they are not resident."[1]

Until the global financial crisis of 2007-09, remittances had proven to be a dependable source of income for households in developing economies, with robust growth regardless of the state of the business cycle. However, as the real-sector spillovers from the financial

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[1] IMF (2009) also discusses the standard components in the balance of payments (BoP) framework pertaining to remittances, including compensation of employees, personal transfers as well as supplementary items related to remittances.

crisis were quite severe, and had a deleterious effect on developed and energy-exporting countries, the principal sources of immigrant remittances, the total quantity of remittances dropped in 2009 for the first time in decades. The World Bank estimated that remittance flows to developing countries reached US$ 307 billion in 2009, a decline by 5.5 percent in contrast to the growth of 16.7 percent in 2008. Because of improved prospects for the global economy, however, remittance flows to developing countries are expected to rise by 6.0 percent in 2010 and 6.2 percent in 2011 (Mohapatra *et. al*, 2010).

Remittance, as a source of development funding, are directly linked to migration. In many instances, particularly in the vulnerable countries, this migration has been forced either by civil conflict, political persecution or economic hardships. For people from the least developed countries (LDCs), migration is often a case of running away from a very difficult situation, rather than a matter of preference. The irony of it is that having escaped their countries, migrants then assist in sustaining the economies of those very countries through remittances.

Remittances can contribute significantly to local, regional and national economic development in migrant-sending countries and also play an instrumental role in reducing poverty as they flow mainly to poor and marginalized families. In many instances, remittances form a significant percentage of total household income, acting as a substitute for earned income lost to unemployment, illness, retirement, emigration, falling wages and crop failure, among others, and ultimately protect poor families against the erosion of what are already basic household assets.

Remittances can generate a positive effect on the economy thorough various channels such as savings, investment, growth, consumption, and income distribution. These inflows can also contribute to stability by lowering the probability of current account reversals. Since they are a cheap and stable source of foreign currencies, remittances are likely to stem investor panic when international reserves are taking a downward trend or external debt is rising.[2] At the community level, remittances create multiplier effects in the domestic economy, producing employment opportunities and spurring new economic and social infrastructure and services, especially where effective structures and institutions have been set up to pool and direct remittances.

A significant portion of relevant literature on remittances argues that they are primarily spent on consumption, housing and land, and are not utilized for productive investment that would contribute to long-run development. In this context, the distinction between "productive and non-productive" uses of remittances needs to be reexamined. The recognition that only a small proportion of remittances are utilized to establish small businesses, improve agricultural practices, or on other forms of 'productive' investment created disillusionment over the development impact of remittances among researchers and policy makers in the 1970s and early 1980s. In recent years, the distinction between consumption and investment has been criticized by researchers that expenditure on

[2] These beneficial impacts are particularly strong for countries where remittances are above 3 percent of GDP as illustrated by Bugamelli and Paterno (2006).

'consumption' items such as health and education should be understood as investment in human capital. As an example, in both the short and long run, investment in education denotes an improvement of the educational infrastructure of the labor exporting economy. Migrants, in combination with high productive physical capital, yield returns that are normally much higher than they would have been if the migrants were employed in their home country. The migrants' family members, that stay behind in their home country, enjoy a higher standard of living through the migrants' savings. Hence, expenditure on consumption and housing produces indirect multiplier effects, which encourage investment and output in related industries. Thus, making a distinction between the productive and unproductive remittances seems quite blur, and both contribute to livelihoods and development, with productive uses contributing more.

Based on the above analysis, the major thrust of this study is to recommend measures for the productive use of remittances. The rest of this paper is planned as follows. The next section examines some general policy measures for employing remittances into productive use preceded by the experiences of South Asian countries in Section III. While Section IV discusses the impact of the growing remittances on the Nepalese economy and lists some measures initiated for attracting more remittances through the official channel, Section V spells out some policy alternatives for mobilizing remittances and using them productively. The last section concludes the study.

II. GENERAL POLICY MEASURES

There are a few policy instruments the government can employ to improve development impact of remittances and enhance the flow through the formal channel. Which policy instruments the government opts depends on the desired goal it intends to achieve. First, if the government's objective is to capture a portion of remittances for development purposes, then the policy instrument could be to impose taxes or levies on remittance transfers, or to explore voluntary check-off for charitable purposes. However, taxing remittances may be counterproductive as this could redirect remittances from the formal channels to informal channels, thus, worsening the balance of payments (BoP). Second, if the government's objective is to stimulate transfers through formal channels and to stimulate capital availability, then the policy instruments could focus on the sale of remittance bonds, opening of foreign currency accounts, premium interest rate accounts, promoting transfers through microfinance institutions, promoting financial literacy, and banking the unbanked. Foreign currency accounts and bonds have proven to be a feasible technique of raising funds. This should be targeted at the Diasporas' middle-to-upper income members.[3] Moreover, if the goal is to stimulate investment of remittances, then the government could reach out to remittance receivers through micro finance infrastructures. The government could also reach out to its migrants abroad through migrants' service bureaus, and tax breaks on imported capital goods by migrants.

[3] For example, India and Pakistan maintain interest rates on foreign currency accounts that are higher than domestic or Euro-currency deposits.

Since a long time, governments of migrants' home countries have employed a large variety of policy measures that target different elements in the system. Multilateral agencies such as the World Bank and the IMF and bilateral development agencies such as the Department for International Development of the UK have also analyzed different policy options and recommendations. Based on this array of experiences, a list of policy measures, including the ones mentioned earlier, is illustrated in Table 1.

Table 1
Policy Measures to Enhance the Development Impact of Remittances

Objective	Measure
Capturing a share of remittances for development purposes	Taxation of emigrants Duties or levies on remittance transfers Voluntary check-off for charitable purposes (or transfer forms)
Stimulating transfers through formal channels and/or stimulating capital availability	Remittance bonds Foreign currency accounts Premium interest rate accounts Promoting/enabling transfers through microfinance institutions (MFIs) Promoting financial literacy/banking the unbanked
Stimulating investment of remittances	Outreach through MFI infrastructure Outreach through migrants' service bureaus Tax breaks on imported capital goods SME schemes (financial, infrastructural, or innovative) Training programs
Outreach to migrant collectives/ Hometown associations (HTAs)	Matched funding Public-private ventures Competitive bidding for development projects
Influencing consumption patterns	Promoting consumption of local goods & services Enabling migrants to spend on their relatives' behalf

Source: Carling (2004).

A few examples as how to tap the skills of the Diasporas are displayed in Box 1 below.

Box 1 : Tapping the Diaspora

Efforts have been undertaken to tap the skills, networks, funds and savings of the Diaspora population. The Chinese Diaspora and Indian information-technology specialists have either reinvested in their countries of origin or have gone home to set up their own businesses; some have even established a commercial presence in other countries. Other government initiatives targeted at assisting the reintegration of returning migrant workers and stimulating investment include the provision of facilities for importing capital goods and raw materials, business counselling and training, access to loans, and encouraging entrepreneurship for development.

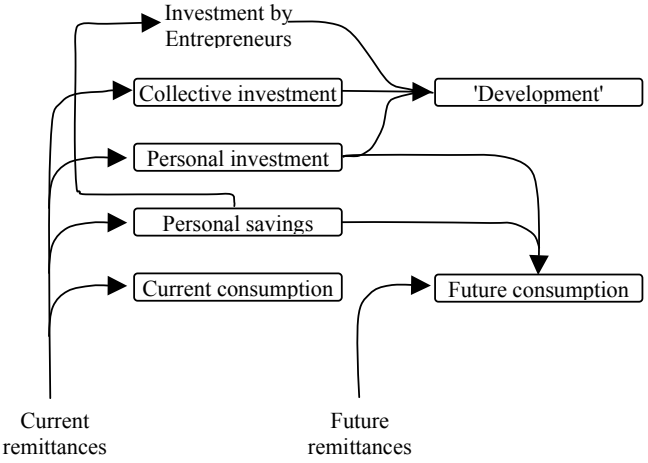
Sending governments could consider the following mechanisms to mitigate the adverse effects of brain drain: requiring migrants to perform public service for critical occupations such as those relating to health care and education; bearing a partial cost of their education if they do not complete the mandatory domestic employment requirement; encouraging return migration by acknowledging their training abroad and giving them visiting scholar positions or other honorary positions and encouraging them to serve as trainers.

Other examples include arrangements that require some compensation from host countries for every foreign worker taken in; exploring the possibility of inviting some of their own experts, practitioners and specialists to conduct training on the advances in the field on a regular, short-term basis as a form of compensating for the loss of skilled workers; establish a special visa scheme to ensure the temporariness of the workers' employment and stay in the host country, thus ensuring return migration.

Source: Puri (2007).

To pinpoint possible policy options for augmenting the benefits of remittances, it is important to take into account the links between remittance usage now, and development and consumption in the future (Figure 1). In this model, 'development' denotes remittance-independent development, that is, future livelihoods that are not dependent on future remittances.

Figure 1: A Model of Remittance Use and Development Impact



Source: Carling (2004).

If remittances today are just spent on consumption, future consumption needs to be financed by future remittances (or other sources of income). However, if remittances are saved or used for investment, this could assist in financing future consumption. Collective investment in development projects will not result in direct future returns to the individual investors; however, this would directly benefit the community. When remittances are saved in financial institutions, this augments credit availability and can enable entrepreneurs to realize investments that have a positive impact on development. This could be a more realistic way of stimulating investment of remittances than promotion of entrepreneurship by migrants or remittance receivers themselves.[4]

III. POLICIES IN SOUTH ASIA

It is growingly acknowledged in South Asia that foreign labor migration helps promote national economic growth, eases the pressure of unemployment, brings in much-needed foreign exchange through remittances and increases consumption, savings and investment at both the household and macro levels.

The Governments of Bangladesh, India, Pakistan and Sri Lanka have devised a legal framework encouraging their citizens to send foreign remittances into their countries of origin. Generally, the non-resident citizens of these countries are granted the following facilities, among others: a) maintenance of bank accounts in both foreign and local

[4] Moreover, there is always a possibility that investors will direct funds into uses with high yields, which could be different from uses with high development impacts. When migrants do invest, their emotional attachment to their regions of origin can help compensate for the disadvantages of these regions in the eyes of purely profit-seeking investors. For details, see Carling (2005).

currencies without tax implications; b) investments in securities/shares, and deposits with local firms/companies; and c) investments in immovable properties in the respective countries. Again, most of the South Asian Governments have established special institutions such as migrant workers welfare funds and have appointed community welfare officers/attaché in embassies in the receiving countries to promote and protect the interest of migrant workers.

India has witnessed an upsurge in returns and investments of its Diaspora population especially after 2006 when it introduced registration certificates called Overseas Citizens of India for persons of Indian origin. They are analogous to green cards, and allow non-resident Indians (NRIs) most of the benefits of citizenship while maintaining their foreign passports. They cannot, however, obtain an Indian passport, vote in Indian elections, own agricultural and plantation properties in India or work for the Indian government. Incentives for returnees include attractive job opportunities, particularly in the areas of software and other information-technology-related jobs, finance, telecommunications, pharmaceuticals and research and development. Many programs have also been launched to attract NRI intellectuals and professors to Indian universities.

India has a wide-ranging package of activities and incentives that accords top priority on building stronger links with its Diaspora communities. These are all orchestrated by the Ministry of Overseas Indian Affairs (MOIA) that was set up in 2004. The MOIA seeks to persuade its Diaspora to invest in long-term ventures, rather than just sending wire transfers and short-term remittances. For meeting this goal, in 2008 the Government launched an Overseas Indian Facilitation Centre, a one-stop shop to help overseas Indians invest in India. Some other initiatives being undertaken by the MOIA include the following:

- Setting up an ICT-driven Diaspora Knowledge Network to draw on India's Diaspora knowledge resources as well as to provide impetus to projects in the Public–Private Partnership mode;
- Establishing a single window for overseas Indian investments to function as a single point contact;
- Operationalizing the electronic remittance facility for overseas Indians that combines the qualities of economy, speed and convenience;
- Launching the scholarship programme for children of overseas Indians to study in India;
- Expanding the Know India programme so that the Diaspora youth would bond with and gain knowledge about India;
- Fully operationalizing a new Overseas Citizenship of India scheme (UNCTAD, 2009).

Because of these and other facilities provided to its non-resident citizens, India has been able to attract enormous remittances from their respective non-resident citizens and has been the world's top remittance earner for more than a decade. It was the largest recipient in 2009 with US$ 55.0 billion, followed by China at US$ 48 billion and Mexico with US$

26 billion (Ratha *et. al*, 2010). The 2009 figure of US$ 55.0 billion was up seven percent from US$ 51.6 billion in 2008, and just two billion dollars a year in the late 1980s.

The rise in remittances in 2009 came despite the global economic slowdown which had been expected to affect migrant labor. The Reserve Bank of India attributed the higher remittances to India being perceived as a relatively safe option during the financial crisis, a rise in interest rates on non-resident deposits and new investment products.

Other factors have also been responsible for the surge in remittances to India. The Government of India eased regulations and controls, and eliminated the black-market premium on the rupee and created convenient remittances services. The Indian and international banks have systematically shifted some remittances from the informal "hawala" channels to formal channels. Indians abroad have also responded to several attractive deposit schemes and bonds offered at home. Again, the Indian Investment centre has devised mechanisms that assist Indian companies to collaborate with NRIs (see Box 2).

Box 2 : Indian Diaspora's Investment Potential

To facilitate the development of enterprises in India, the Indian Investment Centre has developed mechanisms that enable Indian companies to collaborate with NRIs to identify sources of capital and technology. The agency maintains an industrial information service that provides the status of industries and profiles for potential industrial projects. Furthermore, the agency's website provides nonresident Indians with answers to an expansive list of investment questions on bank accounts, repatriation of profits, and investments in securities, shares, company deposits, and property. The site also offers special facilities to NRI investors repatriating funds.

Source: Azad (2005).

With regard to **Bangladesh**, the Bangladeshis working abroad sent home a record US$ 10.72 billion in 2009, as remittances continued to scale new heights despite the global meltdown. This figure was 19.4 percent higher than what the country's more than six million workers had remitted in 2008.

To ensure productive use of remittances, the government, Bangladesh Bank and Schedule Banks designed a number of savings and investment schemes for wage earners abroad. These included the following:

- A migrant can open a non-resident foreign currency deposit (NFCD) account in any branch of Bangladeshi and foreign banks that possess an authorized dealership license. The account can be opened for different periods and are renewable and can be maintained for an indefinite period even after the return of the wage earner.
- The remittances of Bangladeshi migrants abroad can be invested in Bangladeshi currency in five-year wage-earner's development bond which is also renewable. The profits are investable in Bangladesh and principal is freely transferable abroad in foreign currency.

- US Dollar Premium Bond and US Dollar Investment Bond are also available at attractive interest rates.
- The non-resident Bangladeshis are granted permission to invest in 'Industrial Development Bond' scheme of the Agrani Bank, one of the nationalized banks of Bangladesh.
- A non-resident Bangladeshi can purchase shares in both primary and secondary markets including the debentures of Bangladeshi companies. A 10 percent reserve quota has been fixed for a non-resident Bangladeshi in initial public offering (IPO) of the local companies.
- Foreign investors including the non-resident Bangladeshi do not require any approval to set up a new industrial unit, but only have to be registered with the Board of Investment. They receive priority in obtaining industrial facilities like procurement of land, electricity, gas and sewerage connections, import of capital machinery and raw material and tax rebate, among others.

Another aspect that calls for discussion in the case of Bangladesh is the Migrant Welfare Fund (MWF) that was set up from the subscription charges levied on migrants before they leave the country. Passport renewal fees and attestation fees also accumulate in the MWF. Some of the aims of the Fund include the following: a) provision of hostel-cum-briefing centre for the prospective migrants; b) provision of orientation briefing; c) welfare desk at Dhaka Airport; d) burial of dead bodies and providing help to the family of the deceased; e) providing assistance and treatment to the handicapped laborers; and f) establishment of clubs in destination countries.[5]

In Bangladesh, the institutional mechanisms for dealing with remittances are quite exhaustive and have performed their tasks efficiently (Box 3). In order to inform the migrants in host countries effectively and timely with information pertaining to the available remittance service and savings and investment options, the following information and communication channels have been employed:

- Pre-departure briefings for migrant workers by the government's Bureau of Manpower Employment and Training (BMET).
- Migrant worker briefings in social events and meetings in host countries, supported by the labor wings of embassies of Bangladesh.
- Press releases/advertisements in print and electronic media channels popular with the migrant worker Diasporas in host countries and also in Bangladesh for information of families/beneficiaries of migrant workers.
- Information booklets/brochures/pamphlets in hard copy made available through banks in Bangladesh and their clearing arrangement counterparts abroad.
- Websites of the government, central banks, commercial banks and embassies abroad.

[5] For other details on the MWF, see Murshid *et. al* (2002).

Box 3 : Managing Overseas Employment in Bangladesh

There are five government ministries dealing with international labor migration in Bangladesh, the Ministry of Expatriates' Welfare and Overseas Employment being the principal one. The others include the Ministries of Home Affairs, Foreign Affairs, Finance and Civil Aviation, and Tourism. The Bureau of Manpower, Employment and Training (BMET) is the executing agency of the Ministry of Expatriates' Welfare and Overseas Employment in charge of processing labor migration. In particular, the BMET is responsible for a wide range of functions, including control and regulation of recruiting agents, collection and analysis of labor market information, registration of job seekers for local and foreign employment, development and implementation of training programs in response to specific labor needs for national and international labor markets, and resolving legal disputes among key stakeholders.

The government enacted an Overseas Employment Policy in 2006 with the main objectives to: (i) ensure opportunities at reasonable cost for both short-term and long-term migration; (ii) enhance migration opportunities for the skilled and professionals; (iii) manage the recruitment process efficiently; (iv) encourage remittances through formal channels; (v) encourage long-term and short-term migrants to invest in Bangladesh; (vi) assist returning migrants in social and economic reintegration within the country; and (vii) arrange coordination work among related institutions.

Source: Raihan *et. al.* (2009).

As Bangladesh is one of the pioneers in issues involving micro-finance and micro-credit schemes on the one hand, and the successful implementation of linking microfinance institution (MFIs) to remittances in other countries on the other, MFIs involvement in remittances in Bangladesh could be one of the most promising approaches for maximizing the development impact of remittances. MFIs in Bangladesh have operated as distribution agents in remote areas, and administered schemes which support the utilization of remittances for savings and investments for development.[6] This experience of Bangladesh could be emulated by LDCs such as Nepal.

Pakistan registered a high level of remittance inflows equivalent to US$ 7.81 billion in 2009, a rise by 21.1 percent compared to their inflows of US$ 6.45 billion a year earlier. A number of factors were responsible for this state of affairs including the return of some of the expatriates, diversion of remittances partially from informal to formal channels and increased outreach of the banking sector.

In Pakistan, a number of incentives were announced in 2001 reflecting the significance that the government placed on remittances as an instrument for economic development. Linked to a minimum remitted amount (US$ 2,500 to 10,000), overseas Pakistanis were provided privileged access to higher education, public housing and share offerings as well as free renewal of passports and import duty exemption for US$ 700 per year.

[6] A comprehensive examination of the role of MFIs in the utilization of remittances in Bangladesh is provided in Bruyn and Kuddus (2005).

Pakistan introduced a "non-repatriable investment scheme" under which overseas Pakistanis are permitted to import machinery and equipment at concessionary rates of duty to establish manufacturing enterprises. The rate of duty rebate varies, that is, projects in relatively underdeveloped areas are granted a higher rate of rebate. The Investment Advisory Service of Pakistan conducts pre-feasibility studies to facilitate the choice of investment projects. Pakistani migrant workers are also permitted to invest in export processing zones which enjoy complete duty exemptions on machinery and raw material imports.

In order to provide for an ownership structure in Pakistan for remittance facilitation, State Bank of Pakistan, Ministry of Overseas Pakistanis and Ministry of Finance jointly launched the Pakistan Remittance Initiative (PRI) in August 22, 2009. The objective of PRI is facilitating and supporting faster, cheaper, convenient and efficient flow of remittances. The PRI has focused on providing information about the remittance channels and other facilitation to overseas Pakistanis.

Remittances to **Sri Lanka**, on the other hand, increased by 14 percent to US$ 3.3 billion in 2009 compared to 2008. This increase in remittances can be ascribed to the information and financial education provided to them by the Sri Lanka Bureau of Foreign Employment.

Sri Lanka was the first labor-exporting country in Asia to introduce an entrepreneurship development program for return migrants. The main objective of the program, launched in 1982 by the Sri Lankan Ministry of Labor in collaboration with the Merchant Bank of Sri Lanka, was guiding returning migrants in business creation. Many lessons were learnt from this initiative. First of all, return migrants belonging to higher occupational categories were suitable for an orientation program of this type. Secondly, the possibilities for guiding candidates into business were limited unless accompanied by steps to facilitate the access to capital. Three, the ability to identify and develop a project, together with managerial skills needed to run a business, cannot be imparted just through a program of class instruction. [7]

The government also made it mandatory for those going abroad for employment to open non-residential foreign currency accounts. Again, Sri Lankan domestic aides working in West Asian countries were sent for employment only after signing a legal employment agreement. Moreover, the efforts of the government authorities to hold talks with the labor authorities abroad had made it possible to get salary increments for domestic aides in the respective countries.

In Sri Lanka, the Government has attempted to encourage investment and long-term financial planning by return migrant workers by offering different types of credit schemes. The credit schemes do not focus solely on investment but also cater to other identified needs of migrant workers, making them more realistic in application.

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[7] Details of this program are given in Puri and Ritzema (1999).

IV. NEPAL'S EXPERIENCES

One the Nepal's major exports is labor, and most rural households now rely on at least one member's earnings from employment away from home. Nepalese workers have sought foreign employment as both the agricultural and non-agricultural sectors struggle to generate new employment opportunities. With limited arable land, landlessness is pervasive and the number of landless households has steadily increased in the agricultural sector. In the nonagricultural sector, the slowdown in growth, especially since 2000/01, due to the Maoist insurgency and exogenous shocks has further retarded the pace of employment creation. The conflict had also, until recently, created difficult living and security conditions, especially in the rural areas.[8] It had also prompted people to look for overseas employment.

India has been a traditional destination for Nepalese migrants. The primary reasons for this are geographical proximity, historical and cultural links, and a large and open porous border. The 1950 Treaty of Peace and Friendship between India and Nepal formalized free border movement of people. The bulk of these migrants are employed in the private, informal sector. These migrants hold semi-skilled and unskilled jobs in restaurants and factories or are employed as domestic workers, security guards, and maids. However, a significant proportion of the remittances from India are not recorded in the BoP as they are brought in by the migrants themselves or sent through relatives and friends.

An increasingly larger share of remittances now comes from countries other than India, reflecting changing migration patterns and higher earnings in these locations. Moreover, the composition of skills of the labor flows is different among destinations. While migrants to the Middle East are employed mostly as security personnel, chauffeurs, and construction workers, the demand from South East Asian countries is more for employment in industrial enterprises.

Because of the potential positive effect of remittances generally, Nepal has been giving due priority in promoting overseas employment and mobilizing remittances so as to maximize the benefits from these transfers. In this respect, effective March 29, 2002, the Nepal Rastra Bank (NRB) had begun granting licenses to private sector organizations interested in remittance-transfer business. Currently, more than 50 firms, excluding the commercial banks, are undertaking money transfer businesses.

Some other policy initiatives have also been initiated for encouraging the transfer of remittances through the official channel. For instance, the NRB made a provision to provide 15 paisa per US dollar as commission to licensed private firms in addition to the prevailing buying rate. On top of that, permission was granted to manpower agencies, engaged in sending Nepalese nationals to work overseas, to open foreign currency account in the Nepalese commercial banks out of the foreign currency income that they earned under the existing rules.

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[8] This is elaborated in IMF (2006).

A policy arrangement was also introduced whereby if a Nepal-based licensed agent/representative of a money transfer company situated overseas required bank guarantee for receiving advance payment from the principal company, such facility, within the stipulated limits, would be made available directly from the commercial banks.

Again, with an objective to utilize remittances of Nepalis working abroad and bring in the money through the banking channel, in July 2010 the NRB issued a five-year Foreign Employment Bond with an interest of 9.5 percent. The issuance of the bond is expected to facilitate the overseas workers to invest their money in the bond that would be utilized for the government's development programs.

Remittances rose from Rs. 65.5 billion in 2004/05 to Rs. 209.70 billion in 2008/09. Moreover, the share of remittances incoming through the official channel has been going up. For instance, while in 2004/05, out of total remittance income, just about 27 percent flowed into the country through the official channel as against 73 percent through the unofficial channel, in 2009/10, on the other hand, almost 90 percent entered through the official channel and the rest through the unofficial channel.

The upsurge in remittances had led to a surplus in the current account, thereby strengthening the overall BoP position. The share of remittances in total current account receipts, for instance, soared from 38.2 percent in 2004/05 to 56.7 percent in 2008/09 (Table 1). This in turn had enabled Nepal to maintain a very comfortable level of foreign exchange reserves.

Similarly, the remittances to GDP ratio increased from 11.1 percent in 2004/05 to 21.2 percent in 2008/09. These figures clearly indicate that any significant decline in receipts from remittances could disturb the structure of the economy from the macro level. And this is exact what happened in 2009/10, thanks to the delayed impact of the global recession that started to bite the Nepalese economy.

Table 1
Remittances Data

Heading	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10p
Total remittances (in Rs. billion)	65.54	97.69	100.14	142.68	209.70	231.73
Share of remittances to current a/c receipts excluding grants (in %)	38.2	46.7	45.3	51.1	56.7	59.3
Ratio of remittances to GDP (in %)	11.1	14.9	13.8	17.5	21.2	19.6

p - provisional
Source: Nepal Rastra Bank.

As a result, in 2009/10, remittances aggregated Rs. 231.73 billion, a rise by just 10.5 percent compared to its significant growth of 47.0 percent in the previous year. While both in 2007/08 and 2008/09 the upsurge in remittances was responsible for the surplus in the current account and BoP, in 2009/10, the deceleration in the growth of remittances led to a current account deficit of Rs. 32.35 billion, thereby weakening the overall BoP which

also registered a deficit of Rs. 2.62 billion. Analogously, the gross foreign exchange reserves were adequate for financing merchandize imports of only 8.6 months and merchandize and service imports of 10.3 months as at mid-July 2010 compared to 12.3 months and 10.0 months respectively in mid-July 2009. The remittances to GDP ratio fell by 1.6 percentage points to 19.6 percent in 2009/10.

On the basis of data provided by the Department of Foreign Employment, the number of workers going abroad for employment increased by 35.4 percent to 294,094 people in 2009/10 compared to 217,164 people in 2008/09.[9] With the increase in the number of workers, the inflow of remittances should have taken an upswing. However, this did happen.[10]

While remittances shielded the economy during difficult situations in the past, the current global economic crisis has brought a new challenge to the role of remittances. Weak global demand for goods and services and slower economic growth, along with consequent rise in unemployment in host countries, has put the demand for Nepali workers and their remittance transfers at risk. With the decline in remittances, there would be a reduction in household consumption and cutbacks in public spending. Spending on basic necessities such as food, electricity, medicine and schools' fees would also decline.

In terms of uses, however, it has been revealed that remittances in Nepal have been used very little for productive purposes. A small study undertaken by the NRB (2002), covering 10 districts and 160 sample households, showed that the remittance earnings were primarily invested for household purposes, purchase of real estate and house, paying off the loan, purchase of jewellery and as bank deposits.

A few explanations are provided in Box 4 as to why remittances have been used less for productive purposes.

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[9] Out of the total number of people that were given approval for foreign employment, Malaysia was the top destination with a share of 38.5 percent followed by Saudi Arabia, Qatar and the United Arab Emirates.

[10] Major factors could include the lagged impact of sending remittances as well the lack of awareness for sending money through the official channel. Moreover, a large number of manpower agencies hold workers' money for overeseas agents that assist them in securing job orders. For details, see *Republica*, September 11, 2010.

Box 4 : Possible Causes for Less Productive Use of Remittances

The following are some of the reasons as to why migrant workers do not invest in productive uses:

a) Paucity of promotion support in terms of information, advisory, training and other services pertaining to investment in new and potentially successful sectors;
b) Less risk involved in the purchase of land and construction of houses;
c) Hardly any knowledge on investment opportunities;
d) Top priority accorded to household expenditure;
e) Lack of expertise in the remittance receiving household for undertaking a business; and
f) Lack of investment-friendly climate.

V. POLICY ALTERNATIVES

Policies need to be devised to encourage the use of remittances for promoting longer-term growth and income security. Nepal needs to formulate policies that (i) send more remittances through official rather than unofficial channel; (ii) increase the levels of remittances by encouraging migrants to hold their savings in financial assets in the country rather than holding them abroad (or spending their savings on consumer goods); or (iii) encourage migrants to become investor in productive assets in the country.

The opportunity to promote self-employment and small business formation amongst returning migrants and their relations back home should be acknowledged by the government and schemes must be targeted to support investment in business activities. In this light, microfinance is well-placed to address the demand for remittance-linked financial services, particularly among poor and/or geographically isolated populations. MFIs have revealed a competitive advantage based on a host of techniques that reduce the high transaction costs of outreach to poorer clients. By broadening the remittance-linked services to the 'unbanked', MFIs have the potential to promote broad-based development, as well as expanding the volume of remittance flows mediated through the financial system. Hence, MFIs in Nepal could also expand their micro and small business portfolio, while the government and NGOs could provide services such as training, business advice and marketing assistance for micro and small entrepreneurs.

Pooling remittances in MFIs in terms of deposits enables MFIs to finance a wide range of activities, and generate a potentially greater economic and social impact than what could be viable with special targeted business development programs. Moreover, MFIs themselves can utilize remittances to leverage more funds in the commercial markets to finance their growing lending operations. This will enable the MFIs both to diversify their funding sources and also increase the breadth and depth of their outreach. Over time, with more experience, innovative MFIs will find different ways of turning workers' remittances into a productive business that would contribute to their social mission and profitability. Those who receive remittances may also find that MFIs' involvement will provide better ways to manage their inflows. These improvements in both the supply and demand sides can make a significant contribution to increase the welfare of the poor and low-income households.

Banks could make MFIs their working partners in the rural sector for operating microfinance activities. The MFIs would act as loan service agents, and collaborate with social entrepreneurs to set up greenfield MFIs. Under this arrangement, each bank or group of banks could develop microfinance loan portfolio by accumulating the remittances they receive from migrant workers and establishing a network that could eventually distribute a range of financial services throughout the rural areas. As a result, commercial banks would also benefit from the potential of the microfinance sector.

An increasingly recognized policy route is to provide matching funds to the collective remittances sent by migrant organizations abroad, commonly referred to as Hometown Associations or HTAs. Most frequent examples are from Mexico and El Salvador. The local or federal governments in these two countries allocate US$ 2 or more for every dollar migrant organizations remit back in their communities. The pooled funds are normally used to finance infrastructure and social projects, such as remodeling churches and schools.[11] Hence, this mechanism could also be considered in Nepal's case.

Pre-departure orientation program, coupled with awareness-raising initiatives for both migrants and their families, and information dissemination in the destination countries could address the problem of limited awareness about the costs and benefits of seeking employment opportunities abroad and could also act as a powerful tool in raising awareness about remittance methods and utilization. In the destination country, regular meetings should be organized by the Nepalese mission and information should be disseminated through different media by the Government of Nepal. Moreover, returnee migrants also have an important role to play as they can share their experiences with future migrants and their families. Overall, the involvement of a variety of actors (migrant associations, NGOs and governmental bodies) is instrumental in the success of these initiatives.

Financial education can provide remittance receivers with the knowledge and skills to evaluate their options and choose the most suitable financial products, to understand how product features differ, to calculate and compare costs and to determine what they can afford and what products are best suited to their requirements. Financial education empowers the remittance receiver with the knowledge and skills to indulge in a dialogue with the sender about various options for sending remittances through formal channels and how remittances can be used to meet the financial goals of both the sender and the receiver.

It is crucial to encourage migrant knowledge transfer and organization of migrant groups for business development. Diaspora communities are not only a source of funding for projects, but also an important source of human capital, which could well be used in Nepal. Due to their attachment, many migrants could thus be mobilized to assist in

[11] Hence, these HTAs could act as a conduit for development projects. At the same time, once set up, the pooling of resources could also be used to finance local entrepreneurial activities, with the advantage that it could offer returns to investors. For further elaboration, see Agunias (2006).

projects in Nepal, not just through financial contributions, but also by offering time and knowledge.[12]

At the point of origin, as the majority of remittances are utilized to repay loans borrowed from money lenders at high interest rates it is important to explore the possibilities of indulging self- help groups to set up a social fund, which would provide loans with lower interest rates and develop access to institutional credit. This would lower the debt burden of households. Other options such as vocational training, increasing and disseminating information flows pertaining to rural investment opportunities, the provision of loans from financial institutions, developing market linkages for at least some selected non-farm products and services should be delved into by government and non-governmental agencies. The development of entrepreneurial competence would definitely enhance investment in productive activities.

The governments of Brazil, Mexico, India and the Philippines had employed an array of inducements to attract remittance funds to specific saving and investment vehicles, including migrant pension plans, preferential loans or grants for business ventures, preferential access to capital goods and raw material imports for recent returnees, and investment and advisory services for business start-ups.[13] Nepal can learn a great deal from the experiences of these countries.

Likewise, the experiences of South Asian countries in terms of using remittances productively could be very beneficial to Nepal. These include, among others, the incentives provided to its expatriates by the Government of India and the mechanisms devised by the India Investment Centre to help Indian companies collaborate with NRIs, the different savings and investment schemes for wage earners abroad designed by the Bangladesh Bank as well as the role of MFIs for the productive use of remittances, the PRI and the non-repatriable investment scheme launched by the Government of Pakistan and the Sri Lankan Government's entrepreneurship development program for return migrants.

Nepal needs to develop a website to make available information to migrants on remittances transfer mechanisms, prices, and speed and reliability that could improve transparency and further competition in the remittance industry. The website could also provide information on investment opportunities back home, immigration policies in destination countries and links to websites of the Nepal government and non-government institutions that work with the Diaspora, return migrants, micro-credit institutions, and business development.

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[12] An example is the case of Algeria where its government realized the potential benefit from human capital, and formed an Algerian transnational network of researchers and engineers; thus students that remain in the host countries (Europe and the US) transform the brain drain into brain gain. The underlying idea is that contributions by these groups of migrants can stimulate small and medium starts-up in high-tech sectors such as biotechnologies for agriculture which is strongly needed to improve productivity. For details, see European Investment Bank (2005).

[13] These mechanisms of different countries are cited in Sander (2003).

The setting up of a special category of deposit accounts at commercial banks where migrant workers can deposit their money earned abroad is one of the common incentives utilized in many countries to attract money transfers from abroad. These special deposit accounts grant migrants preferential interest rates and the choice to have accounts denominated in foreign currency. Other incentives schemes include special training schemes for migrants to open small businesses back home, and granting premium interest rates on remittance funds.

With regard to the global recession, it is exigent to conduct continued assessment of the impact of the worldwide financial meltdown on the economic situation in those destination countries where there are a large number of Nepali migrant workers. This would assist in forming the basis for estimating job losses for Nepali migrants and the number of returnees.

VI. CONCLUSIONS

Remittance flows are a crucial policy concern since they are very large in size, are relatively stable and provide a cushion for economic shocks, and are unique in providing direct benefits for households. However, remittances do not automatically contribute to national development. To carry out effective and efficient public policies to channel remittances into productive projects, the government has to look at what motivate Nepalis to send money home particularly beyond individual family remittances, and craft its policies to take advantage of it. While the policies and initiatives undertaken so far to augment the impact of remittances are primarily aimed at encouraging the sending of remittances through official channels, the utilization aspect of remittances has been largely ignored by the government authorities.

Hence, directing remittances to productive investments is a challenge for the government. Families of migrant workers should be encouraged and trained so that they are able to undertake small businesses. This will generate jobs and help improve the domestic economy. In the long run, migrant workers can come back and be reintegrated in the country, bringing in better skills and technology.

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Spatial Price Integration in Nepal

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Abstract

There is a large volume of literature documenting the analysis of spatial market integration based on individual commodity prices. This paper, instead, contributes to the literature by delineating the existence of spatial market integration using intra-regional price indices. In this context, we use monthly price indices for Kathmandu valley, Hill and the Terai region, which are the only available spatial indices in Nepal. Employing Johansens' bi-variate cointegrating approach for the period from August 1995 to December 2010, we found a strong proposition of Law of One Price (LOP) across the region indicating the fact that spatial markets are highly integrated albeit speed of adjustment is rather slow. This may be due to the existence of oligopolistic pricing behaviour, carteling, asymmetric market information, and syndicate in the transportation system as discussed in various literatures.

I. INTRODUCTION

As monetary policy in many countries aims to keep inflation (i.e. changes in prices) within the target band so as to ensure economic stability and sustainable growth, it is inevitable to know the likely inflation in advance for adopting appropriate policy measures. An analysis of spatial price relationship helps to understand how price shocks in one region transmit to other regions and whether regional markets are integrated in the economy, which ultimately helps to forecast inflation in a more comprehensive way.

Spatial price relationship measures the degree to which markets at geographically separated locations share common long-run price or trade information on a homogenous product (Goodwin and Piggott, 2001). In this context, spatial markets are said to be integrated if price shocks in one market are reflected into other markets (Lohano and Mari, 2005). A poorly integrated or virtually non-integrated market conveys inaccurate price information, as price changes in one region do not necessarily reflect the relevant economic phenomena of other regions, which leads to inefficient product movements and market decision (Goodwin and Schroeder, 1991). This may be a common phenomenon in

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underdeveloped market where oligopolistic or monopolistic pricing behavior is more pronounced.

Competitions among arbitragers ensure a unique equilibrium price in spatially integrated markets where the spatial prices differ only by transfer and transaction costs (Rapsomanikis et. al., 2003). The premises of fully integrated spatial market correspond to those of the standard competition model characterized by frictionless undistorted world or the Law of One Price (LOP) where pricing along the production chains depend on production costs (Conforti, 2004). Therefore, the analysis of spatial price integration provides an important policy feedback in identifying whether spatial markets are functioning in a predictable way, and price signals are passing-through consistently in different markets (Lohano and Mari, 2005).

The existing empirical literatures focus generally on how the prices of particular commodity integrate across the region in order to analyze the proposition of market integration (see Ohen et. al, 2007, Sedaghar, 2007 and references therein). The basic motivation of this paper, unlike the existing literature on price integration, is to explore the degree of spatial market integration in Nepal using regional consumer price indices. These indices are considered to be homogeneous in terms of commodity-price baskets and expenditure weights across the regions (Annex 1 and 4). In this context, we aim to explore how regional markets are integrated and whether price shocks in one region transmits quickly to the other regions. As overall national consumer price index is the weighted average of the three regional price indices, an analysis of spatial market integration is important to establish the linkage between regional and national prices.

The objective of this paper is, therefore, to measure the degree of market integration among the three regional markets of Nepal, namely Kathmandu valley, Hill and the Terai. Following Johansen's bi-variate cointegrating method for monthly data frequency from August 1995 to December 2010, we draw a number of interesting conclusions. First, we find a strong proposition of LOP across the regions indicating the fact that regional markets are highly integrated. However, price adjustment is rather slow across the region as it has taken as long as one and half year to return to long run equilibrium after any shock arises. Second, consumer price index of Hill region is highly influenced by both the price indices of Kathmandu valley and Terai region but reverse causality is not found true. Finally, the regional price adjustment between the Terai and Kathmandu valley is found faster than that of the price adjustments between Hill and the Terai and between Hill and Kathmandu. The conclusion should, however, be taken cautiously because the entire analysis is based on monthly price index due to unavailability of high frequency price data.

The rest of the paper is organized as follows. The next section describes conceptual framework of spatial market integration followed by econometric methodology in section three. Section four discusses properties of time series variables while section five provides empirical results. Finally, the last section draws the conclusion.

II. CONCEPTUAL FRAMEWORK

An analysis of spatial price relationships, which states how prices transmit from one region to the other, is a common practice in assessing market integration. The empirical analysis generally suggests that markets are independent, or not integrated if price relationships do not exist or even exhibits negative relationships. On the other hand, markets are weakly integrated if the price movement is positive. Moreover, if the relative prices are stable in two markets, the LOP holds true (Asche et. al., 2005). We utilize this conceptual framework to analyze the extent of market integrations across the spatial region in Nepal by employing regional price indices as against the use of individual commodity prices.

Let us consider the overall price behavior in two regions as $cpi_t^K = cpi_t^T + k_t$ where cpi_t^K and cpi_t^T are consumer price indices of Kathmandu valley and the Terai region respectively at time t. These two regional markets are considered to be integrated if cpi_t^K equals cpi_t^T with some transfer costs, k_t (Tomek and Robinson, 2003). But, this may not be the case if spatial markets are not perfectly competitive in which case the trade between two regions occurs as a result of greater absolute price difference than the transfer cost, viz. $\left|cpi_t^K - cpi_t^T\right| > k_t$. This allows additional profit margin and hence motivates the trading business. However, unexpectedly high transfer costs as well as additional profit margins hinder the transmission of price signals which may prohibit arbitrage. The phenomenon of oligopolistic behavior, carteling activities, collusion among domestic traders, asymmetry of price information, syndicate in transportation, market rigidities, among others, may retain price differences significantly higher than those determined by actual transfer costs (Rapsomanikis et al., 2003).

In a more systematic way, the concept of market integration can be expressed in a simple empirical model as:

$$\log(cpi_t^K) = \alpha + \beta \log(cpi_t^T) \qquad (1)$$

Where, α is a constant term that captures transfer costs and β gives the price relationship between these two markets (Asche et. al., 2005). In this framework, if $\beta = 0$, the price change in the Terai does not affect the price change in Kathmandu valley and it implies that these two markets are independent or there is an absence of market integration. This is, in fact, seldom in modern economy as markets are associated by one means or the others. On the other hand, spatial markets are considered to be integrated or LOP holds true if $\beta = 1$ in Eq(1)

One of the popular methods of estimating spatial market integration is to test the axiom of strong and weak version of LOP. According to the strong version, spatial prices are equal and they move perfectly together if $\alpha = 0$ and $\beta = 1$ in which case the trading goods are

substitutes. In real life, the strong version of LOP is seldom. The weak version is possible which states that only the price ratio may be constant but the actual spatial price level is different due to transfer costs and profit margins. The necessary condition for the weak LOP are $\alpha \neq 0$ and $\beta = 1$.

III. ECONOMETRIC METHODOLOGY

Based on the above conceptual framework and following Johansen (1988) and Johansen and Jueselius (1990), we employ a bi-variate cointegrated reparameterised vector autoregressive model of order p to investigate the spatial price relation between the price indices of (a) Kathmandu Valley and the Terai, (b) the Terai and Hill, and (c) Hill and Kathmandu Valley as follows:

$$\Delta X_t = \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-i} + \prod X_{t-p} + \mu_t + \varepsilon_t \qquad (2)$$

In Eq (2), X_t is an 2×1 vector of the first-order integrated [i.e., I(1)] variables; μ_t is an $2x1$ vector of deterministic term; ε_t is an $2x1$ vector of normally and independently distributed error terms, i.e., $\varepsilon_t \approx NP(0, \Omega)$; Γ_i are 2×2 coefficient matrix of lag variables, defined as $-\sum_{j=1+1}^{p} A_j$ and finally, $\prod$ is an 2×2 long run impact matrix, $-(I - \sum_{i=1}^{p} A_i)$ where A_i is an $2x2$ matrix of vector autoregressive of order p and I is an $2x2$ identity matrix.

The rank of $\prod$ determines the number of cointegrating vectors (r) among the variables in X_t. We expect $0 \leq r \leq 2$. In the extreme case if r=0 then we do not find any cointegrating relationships between two spatial price indices. On the other hand, if r=2 there exists a full rank, i.e there exists bio-directional causal relationship. If $\prod$ is of rank r such that $0 < r < 2$ then we can decompose $\prod = \alpha\beta'$ where α is an $2 \times r$ matrix of error correction coefficients which provide the speed of adjustment towards long run equilibrium and β' is an $2 \times r$ unrestricted cointegrating vectors (Kharel and Koirala, 2010). Eq(2), then, can be re-written as:

$$\Delta X_t = \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-i} + \alpha(\beta' X_{t-p}) + \mu_t + \varepsilon_t \qquad (3)$$

Testing number of cointegrating relationships, r, is an important issue in Eq(3) because the long run relationship between two price indices cannot be indentified if $r \neq 1$.

Johansen (1988) proposes two likelihood ratio tests namely eigenvalue [$\lambda_{\max}(r/r+1)$] and trace statistic [$\lambda_{trace}(r/p)$] tests for the determination of r as follows:

$$\lambda_{trace}(r/p) = -T\sum_{i=r+1}^{p}\log(1-\hat{\lambda}_i) \quad (4)$$

$$\lambda_{\max}(r/r+1) = -T\log(1-\hat{\lambda}_{r+1}) \quad (5)$$

where $\hat{\lambda}$ is computed eigenvalue up to p lags and p is chosen up to the level which removes serial correlation. Eq(4) tests the null hypothesis that there are at most r cointegrating vectors against k where k is number of variables used in the model, whereas Eq(5) tests the null hypothesis of r cointegrating vectors against the alternative of r +1.

Next, we impose different restrictions on cointegrating vectors, $\alpha\beta'$, to test whether the LOP proposition holds and whether transfer costs exist in the spatial markets. The extended form of $\alpha\beta'$ can be written as:

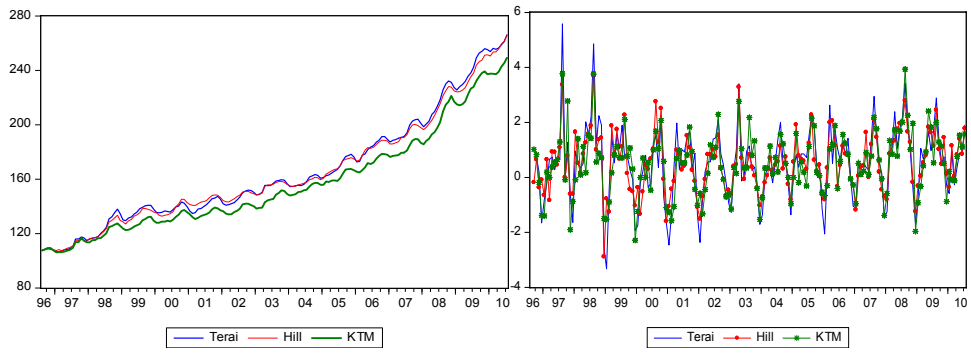
$$\prod = \alpha\beta' = \begin{bmatrix}\alpha_1\\ \alpha_2\end{bmatrix}[\beta_1 \quad \beta_2] \quad (6)$$

If $\beta_1 = -\beta_2$ (or $\beta_2 = -1$ if β_1 is normalized to 1) in our bi-variate cointegrating space, the price relationship is proportional, i.e. LOP holds between two variables under consideration. The parameter α measures the degree of price adjustment. Accepting the restriction $a_1 = a_2 = 0$ implies that the long run relationship does not exists between two variables while $a_1 \neq a_2 \neq 0$ implies that there is no leading price in the system.

IV. THE DATA AND PRELIMINARY ANALYSIS

As high frequency price indices are desirable to investigate spatial market integration, they are unavailable in Nepal. We use monthly spatial price indices from August 1995 to December 2010, covering a total of 185 observations. Spatial price indices imply three different urban consumer price indices namely, price index for Kathmandu valley (cpi_t^K), price index for Hill (cpi_t^H) and price index for Terai (cpi_t^T). We obtain data from Quarterly Economic Bulletin (Nepal Rastra Bank) and use only log level of variables unless otherwise stated.

Figure 1: Spatial Price Indices and Monthly Inflation
(Base year: 1995/96=100)



Panel A: Price Indices Panel B: Monthly Inflation rate in Percent

Figure 1 plots the variables both in level and first difference. The Panel A presents plot of spatial price indices which indicate both high correlations among the indices across the regions and auto-correlation of the indices over the years. Panel B depicts spatial inflation rates, defined as percentage change in price indices over the previous month, which shows that monthly inflation rates are highly volatile and co-related, but are stationary.

Table 1 presents the unit root tests of spatial prices indices using both the Augmented Dicky Fuller (ADF) and the Phillip Perron (PP) tests (Phillips and Perron, 1988). We confirm that price indices follow unit root process at level but they are stationary at first difference, i.e. I(1).

Table 1: Unit Root Test

Variables	Augmented Dickey-Fuller (ADF) Test				Phillips-Perron (PP) Test			
	Level		First difference		Level		First difference	
	Constant	Constant and Trend	Constant	Constant and Trend	Constant	Constant and Trend	Constant	Constant and Trend
cpi_t^K	1.401	-0.667	-7.800*	-7.666*	1.724	-0.812	-7.415*	-7.583*
cpi_t^H	1.082	-0.888	-7.114*	-7.223*	0.902	-1.197	-6.985*	-7.019*
cpi_t^T	0.579	-1.588	-7.767*	-7.802*	0.624	-1.565	-6.988*	-6.919*

*Note: Critical values for rejecting the null hypothesis at 1%, 5% and 10% significant level are -3.472, -2.880 and -2.576 respectively for the ADF test and -3.469, -2.878 and -2.576 respectively for the PP test respectively. * indicates that the variable is significant at 1% level.*

We then investigate the pair-wise correlation of price indices between (a) Kathmandu Valley and Terai, (b) Kathmandu Valley and Hill and (c) Hill and the Terai region. As expected, correlation coefficients are found to be more than 0.99 in all combinations. This

implies that price linkages across the regions are very strong (Table 2). However, the correlation coefficients of monthly inflation rates depict some interesting results. Geographically, as Kathmandu valley is surrounded by Hill and Hill is attached to Terai, one may expect a high correlation between the inflation of Kathmandu and Hill, and Hill and Terai but this is not the case. As such the correlation coefficient of inflation rates between Kathmandu valley and Hill is slightly lower (0.81) than both Kathmandu and Terai (0.82) and Hill and Terai (0.85). We believe that a relatively low correlation between Kathmandu Valley and Hill is due mainly to lack of effective transportation and communication system between these regions.

Table 2: Correlation Coefficients

Type\region	cpi_t^K **and** cpi_t^H	cpi_t^K **and** cpi_t^T	cpi_t^H **and** cpi_t^T
Price index (in log level)	0.9971	0.9974	0.9984
Monthly inflation*	0.8145	0.8224	0.8582

** Defined as percentage change of indices over previous month.*

The Granger causality tests as shown in Table 3 provide further insights to spatial price linkages. We find that cpi_t^K Granger causes cpi_t^T and cpi_t^H. Similarly cpi_t^H Granger causes cpi_t^T. This implies that price movement of Kathmandu Valley determines the price movements of both the Terai and Hilly regions. Similarly, price movement of Hill causes the price movement of the Terai region.

Table 3: Granger Causality Test

Direction of causality	**F-Statistics**	**Probability value**
$cpi_t^K \rightarrow cpi_t^H$ $cpi_t^H \rightarrow cpi_t^K$	14.304 0.357	0.000 0.700
$cpi_t^T \rightarrow cpi_t^K$ $cpi_t^K \rightarrow cpi_t^T$	1.120 10.476	0.328 0.000
$cpi_t^T \rightarrow cpi_t^H$ $cpi_t^H \rightarrow cpi_t^T$	1.899 6.951	0.153 0.001

Note: Variables are in log level. The Granger causality is tested using up to second lag.

V. EMPIRICAL ANALYSIS

As the objective of this study is to examine the regional market integration in Nepal by analyzing bi-variate price dynamics between (a) cpi_t^K and cpi_t^T, (b) cpi_t^H and cpi_t^T, and (c) cpi_t^K and cpi_t^H, the first step is to run Eq(3) to test whether there exists cointegrating relationship between different combinations of spatial price indices. The empirical results utilizing Johansen Maximum Likelihood procedure are presented in Table 4 where

Granger's causality test is followed to keep variables in order. We used for all variables up to second lag which satisfies both AIC and SC criterion.

Table 4 : Johansen Maximum Likelihood Procedure (p=2)

Model	Null Hypothesis	Maximal Eigen Value			Eigen-values	Trace		
		Alternative Hypothesis	Max. Eiger Statistics (λ_{max})	5% Critical Value		Alternative Hypothesis	Trace Statistics (λ_{trace})	5% Critical Value
$\log(cpi_t^T)$, $\log(cpi_t^K)$	$r = 0$	$r = 1^*$	12.409	15.67	0.0724	$r \geq 1^*$	21.292	19.96
	$r \leq 1$	$r = 2$	8.883	9.24	0.052	$r \geq 2$	8.883	9.24
$\log(cpi_t^H)$, $\log(cpi_t^K)$	$r = 0$	$r = 1^*$	20.209	15.67	0.1152	$r \geq 1^*$	26.327	19.96
	$r \leq 1$	$r = 2$	6.117	9.24	0.0363	$r \geq 2$	6.117	9.24
$\log(cpi_t^H)$, $\log(cpi_t^T)$	$r = 0$	$r = 1^*$	17.450	15.67	0.1003	$r \geq 1^*$	25.709	19.96
	$r \leq 1$	$r = 2$	8.258	9.24	0.0488	$r \geq 2$	8.258	9.24

*Note: r denotes the number of cointegrating vectors. The critical values are from Osterwald-Lenum (1992). *denotes rejection of the hypothesis at 5%.*

As shown in the Table 4, we reject the null hypotheses of no cointgration (i.e. r=0) for all sets of bivariate combinations using both the $\lambda_{\max}$ and λ_{trace} tests as against the alternative hypotheses of at least one cointegrating relationship (i.e. r=1). However, we reject the null hypotheses of more than one cointegrating relationship at 5 percent significant level in all cases. The Eigen value is also maximum when r=1 compared to the values when r=2. Therefore, the results of the cointegrating relationship using both the $\lambda_{\max}$ and λ_{trace} tests suggest that there is only one cointegrating relationship in each pair of (a) cpi_t^T and cpi_t^K, (b) cpi_t^H and cpi_t^K, and (c) cpi_t^H and cpi_t^T.

The error correction representation (ECR) of the cointegrating result is an important way of presenting the variables into the short run dynamics and the long run relationships into a single model (Johansen 1988). As we have single cointegrating relationship in each bi-variate model, the error correction representation of the estimates can be presented as follows:

$$\Delta \log(cpi^H) = \underset{4.84}{0.57}\Delta \log(cpi_{t-1}^H) + \underset{2.54}{0.33}\Delta \log(cpi_{t-2}^H) + \underset{1.24}{0.14}\Delta \log(cpi_{t-1}^K) - \underset{2.66}{0.15}\Delta \log(cpi_{t-2}^K)$$

$$- \underset{3.37}{0.08}(cpi_{t-1}^H - \underset{34.59}{1.05}cpi_{t-1}^K - \underset{1.09}{0.17}) \qquad (7)$$

$$\Delta \log(cpi^{H}) = \underset{2.71}{0.36}\Delta \log(cpi^{H}_{t-1}) + \underset{2.20}{0.30}\Delta \log(cpi^{H}_{t-2}) + \underset{1.15}{0.12}\Delta \log(cpi^{T}_{t-1}) - \underset{2.69}{0.29}\Delta \log(cpi^{T}_{t-2})$$

$$- \underset{2.89}{0.07}(cpi^{H}_{t-1} - \underset{37.25}{1.00}\Delta cpi^{T}_{t-1} - \underset{1.17}{0.02}) \tag{8}$$

$$\Delta \log(cpi^{T}) = \underset{3.67}{0.46}\Delta \log(cpi^{T}_{t-1}) - \underset{2.20}{0.02}\Delta \log(cpi^{T}_{t-2}) + \underset{1.47}{0.07}\Delta \log(cpi^{K}_{t-1}) - \underset{0.18}{0.08}\Delta \log(cpi^{K}_{t-2})$$

$$- \underset{1.05}{0.054}(cpi^{T}_{t-1} - \underset{37.57}{1.11}cpi^{K}_{t-1} - \underset{0.05}{0.45}) \tag{9}$$

The price dynamics between the Hill and Kathmandu valley is given in Eq(7) while Eq(8) provides the same relationship between the Hill and Terai region. Eq(9) describes the price linkages between the Terai and Kathmandu Valley. All estimates are meaningful and consistent with theories as error correction terms are significant with their expected negative sign and long run estimated parameters as well as most of the short run coefficients are significant. Our results show interesting insights of market integration across the region in Nepal.

We find that the price movement in the Hill region is explained by both the price movement in the Kathmandu Valley and the Terai as depicted in Eq(7) and Eq(8) while the price movement in the Terai is influenced by the prices of Kathmandu valley as shown by Eq(9). Thus, as a capital city with high density of population, price movement in Kathmandu valley can be an important factor determining the price movement in both the Terai and Hilly regions. Though price movement in the Terai region is highly influenced by the Indian prices due to a long open boarder as suggested by many empirical literatures, we find that price transmission from Kathmandu valley is also important for the determination of prices in Terai region.

Spatial markets are highly integrated in Nepal but the speed of price adjustments across the regions are found to be rather slow. The error correction coefficients ranging between 0.05 and 0.08 in this study depict the fact that it may take around one and half year to adjust price fully from one region to other when price shocks arises. For instance, the error correction coefficient of 0.08 in Eq(7) is interpreted as that any price shocks for the price movement in the Kathmandu valley, would be corrected by 8 percent per month to restore into long-run equilibrium. Among the three sets of bi-variate combinations, the price adjustment between Kathmandu valley and Hill is faster than that of between Terai and Kathmandu valley.

Table 5: Test of Law of One Price Across the Region (LOP)*

Model	$\beta_2 = -1$	$a_1 = 0$	$a_2 = 0$
log(cpi_t^T), log(cpi_t^K)	-1.11 (0.08)	3.426 (0.064)	2.766 (0.962)
log(cpi_t^H), log(cpi_t^K)	-1.05 (0.03)	7.96 (0.004)	0.35 (0.55)
log(cpi_t^H), log(cpi_t^T)	-1.01 (0.027)	0.486 (0.034)	0.24 (0.624)

* *Reported corresponding t-test statistics. Figures within parenthesis are probability values.*

The long run coefficients as depicted in all ECR equations are represented in the column (2) of Table 5 with values close to 1 and are statistically highly significant along with significant intercepts. The result implies that relative prices are constant across the regions holding LOP true throughout the regions. We carry out further tests to examine the degree of price correction resulting from price difference in specific region as indicated by α parameters in column (3) and (4) of Table 5.

The parameter α measures the degree of price adjustment. Accepting the restriction $a_1 = a_2 = 0$ implies that the long run relationship does not exist between two variables while the restriction $a_1 \neq a_2 \neq 0$ implies that there is no leading price in the system. The nonrejection of the restriction $a_2 \neq 0$ throughout the equations (in column 4) suggests that a change in the price difference corrects at least partly by a change in prices in the other market. However, the consistent rejection of $a_1 \neq 0$ in all the specifications (in column 3) implies that a change in the price difference does not correct partly by the change in the price at the same market.

Although the LOP holds, several reasons might have contributed for attaining a slow speed of adjustment in the price integration across the regions. The syndicate system in the transportation may be one of the good reasons for lack of quick prices integration as this has been the case for several years in Nepal. The oligopolistic market behavior, especially carteling, is another pertinent reason for a slow pass-through of prices across the region. The transaction as well as transportation cost throughout the regions is considerably high which also results in a slow adjustment of prices from one region to another. For instance, the price adjustment in the Hilly region as a result of price rise in the Kathmandu Valley is very slow due to the existence of Hill markets in difficult geographical location. Some strategically important department stores, wholesalers and even some retail shops play a vital role in the determination of the prices in Nepal. Such activities hinder a smooth flow of goods from one region to another, and hence distort price adjustment.

Some methodological aspects should also be considered in order to validate the slow speed of adjustment in price integration across the region. First, we employ aggregated price indices which include both more sensitive and less sensitive items in the price baskets. For example, price rise in school education in Terai does not necessarily change

the same price in Kathmandu Valley. On the other hand, any price change in petroleum product in Terai will have a proportional impact in Kathmandu Valley. Second, the study use monthly price indices, a high frequency data may give a different result as price shocks may transmit quickly than the monthly interval.

VI. CONCLUSION

This paper investigates spatial market integration in Nepal analyzing monthly price indices of Kathmandu Valley, Hills and the Terai for the period from August 1995 to December 2010. Using Johansens' bi-variate cointegrating method, we find that spatial markets are integrated across the region in Nepal but the pace of adjustment is uniformly slow as it takes as long as one and half year to adjust price fully if price shock arises. A slow speed of price adjustment across the region as found in this study reveals that Nepalese market is still experiencing various structural as well as price rigidities. The oligopolistic behavior, carteling, asymmetric information, syndicate in the transportation system, among others, may have been responsible for the slow adjustment. Our findings, however, should be taken cautiously because the entire analysis is based on the monthly price indices; high frequency data may give different result. Similarly, this study used aggregated regional consumer price indices; an analysis with decomposing high sensitive and less sensitive price items may alter the result.

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Annex 1 : An Overview of Price Indices in Nepal

The history of price statistics is not very long in Nepal. The "Gorkhapatra", a daily national Newspaper, started publishing retail prices of few commodities since 1902 albeit in an irregular basis. The Kathmandu Municipality Office, then, started publishing retail price of consumers' goods in monthly basis since 1956 but it could not sustain for a long time (NRB, 1981). A systematic effort of collecting price statistics begins in Nepal since 1962 when the Central Bureau of Statistics started compiling weighted average of consumer price index for Kathmandu Valley which was continued till 1969/70.

At the same time, Nepal Rastra Bank (NRB) started compiling price statistics of essential consumer goods since its establishment in 1956. Initially, the Bank collected prices of 15 commodities in a fortnightly basis. The number of commodities in the price basket was increased to 31 in 1960 and 46 in 1965. In terms of the geographical coverage, the Bank started compiling un-weighted price index for Kathmandu valley since 1957 and extended it for compiling a separate price index for Terai region since 1962 and for Hill region since 1963 (Pandey, 2005). Following the international practice of determining weights for the price indices, Nepal Rastra Bank conducted the first household survey in 1972/73 followed by second survey in 1982/83 and the third in 1994/95. The available monthly, quarterly and annual price series by region between 1973/74 to 1982/83 are based on the fixed weights carried out from the first household survey. Similarly, the price weights between 1983/84 to 1994/95 and then 1995/96 to 2009/10 are based on the second and third household survey respectively. The current price indices are based on the fourth household survey which was conducted in 2005/06.

A continuous effort have been made to improve the price indices extending the coverage in terms of price collection area and the number of items but price indices in Nepal are still based on the selected urban areas with limited number of goods and services. This implies that current CPI in Nepal does not cover the price movement in rural and mountain areas. Even within the selected urban areas, the current annual price index of Kathmandu valley is based on the 301 price items collected from 4 urban centers whereas the price index of Terai and Hill region are based on 267 price items collected from selected 10 urban centers and 284 items collected from 7 urban centers respectively (Annex 3). The national urban consumer price index, which is popularly known as the Consumer Price Index (CPI), is, then computed as the weighted average of regional price indices where the weights assigned to regional series are based on the proportion of total population residing in the region (Annex 2).

Although regional price indices are derived independently employing Laspeyres (Chance, 1966) method including regional weights and prices, they are comparable as most of the items selected in the price basket are identical. Moreover, the weighting structure also follows the same pattern as weights given to food and beverage items in Terai region is 54.98 percent since 1995/96 whereas it is 53.04 in Hill and 51.53 in Kathmandu (Annex 4). Consequently, the remaining share goes to non-food and service items in all regions.

Annex 2 : Price Basket and Regional Weights (1995/96 to 2009/10)

Region	No. of urban centre	Name of urban Centres	Regional Average Weight
Kathmandu	*4*	Kathmandu, Lalitpur, Bhaktapur and Thimi	*0.3082*
Terai	*10*	Damak, Biratnagar, Lahan, Janakpur, Birgunj, Bharatpur, Sidharthanagar, Nepalgunj, Mahendranagar and Dhangadhi	*0.5043*
Hill	*7*	Ilam, Dhanakuta, Hetauda, Pokhara, Banepa, Dipayal and Birendranagar	*0.1875*
Overall	*21*		*1.0000*

Source: Nepal Rastra Bank, Research Department, Price Division

Annex 3 : Number of Items Selected for Price Collection (1995/96 to 2009/10)

	Total	Weekly	Fortnightly	Monthly	Quarterly	Half Yearly	Yearly
KTM	301	51	44-47	60-67	84-85	36-40	11
Terai	267	44-45	37-40	56-60	75-77	32-34	9-10
Hill	284	52-56	36-40	55-60	71-79	33-37	10-11

Source: Nepal Rastra Bank, Research Department, Price Division

Annex 4 : Weight Structure of Major Items Across the Region (in percent) (1995/96 to 2009/10)

Items\Ecological regions	Terai	Hill	KTM	Overall
All Items	***100.00***	***100.00***	***100.00***	***100.00***
Foods and beverages	***54.98***	***53.04***	***51.53***	***53.20***
Grains and cereals products	19.76	17.76	16.37	18.00
Pulses	3.35	2.66	2.14	2.73
Vegetables, fruits and nuts	7.63	7.61	8.27	7.89
Spices	2.06	2.01	1.57	1.85
Meat, fish and eggs	5.02	5.48	5.28	5.21
Milk and milk products	3.98	3.94	4.18	4.05
Oil and ghee	3.23	3.77	2.62	3.07
Sugar and related products	1.09	1.15	1..36	1.21
Beverages	2.00	2.65	2.39	2.28
Restaurant meals	6.86	6.01	7.35	6.91
Non-food items and services	***45.02***	***46.96***	***48.47***	***46.80***
Cloths, clothings and sewing services	9.16	8.94	8.67	8.92
Footwear	1.78	2.63	2.41	2.20
Housing	14.80	14.40	15.14	14.87
Transport and communication	4.16	3.31	4.21	4.03
Medical and personal care	8.04	8.39	7.86	8.03
Education, reading and recreation	5.54	7.78	8.33	7.09
Tobacco and related products	1.54	1.51	1.85	1.66

Source: Nepal Rastra Bank, Research Department, Price Division

Examining Volatility of Interbank Rate in Nepal

Suman Neupane*

Abstract

This paper attempts to examine volatility pattern of interbank rate of Nepal using daily and monthly data. The empirical results show significant variation in volatility during the period of study. It depicts the clustering of large and small variances of interbank rate. Moreover, as the sum of ARCH and GARCH coefficients are greater than unity in the daily interbank rate, shocks are highly persistent in the interbank market. However, the SLF of NRB has been observed to lower the persistence of shocks, as the sum of ARCH and GARCH coefficients decreases when effect of SLF and repo are introduced in the model. It depicts that SLF and repo of NRB has been effective to lower the persistence of shocks on daily interbank market, but it increased the mean of conditional volatility. The other important finding of the study is that mean conditional volatility is highest in February and lowest in August.

I. INTRODUCTION

Interbank rate is an interest rate at which banks borrow and lend their funds in the money market for short term. It is an overnight lending of one bank to another. Most importantly, it contains information whether the market is tight or excess of liquidity. The rate gives essential signals for central bank to understand the money market condition.

In liberal economy, the interbank rate (IBR) is closely linked with other interest rates in the market. Therefore, many central banks implement monetary policy in such a way that the interbank rate does not deviate much from the central bank's policy rates. Understanding volatility of interbank rate is important for the central bank to identify whether the pressure on interbank rate arises from demand side, supply side or exogenous factors and whether intervention in market is required or it dies out automatically.

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Remarks: The views expressed in this paper are those of author and do not necessarily represent those of the Nepal Rastra Bank

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Van't Dack (1999) observes that most central banks favor a smooth trend in key short-term interest rates and are willing to act towards reducing volatility. This is because volatile interest rates are often seen as obscuring policy signals, while more orderly market conditions are often seen as promoting a more rapid and more predictable transmission of monetary policy. Also, less volatile interest rate conditions are seen as helpful for financial institutions in better management of their exposure to market risks. Gray, Hoggarth and Place (2000) argue that central banks consider volatility in short-run interest rates to be potentially harmful to the economy; so they choose to smoothen the change in the price of money whenever possible.

Recent developments in financial econometrics suggest the use of nonlinear time series structures to model the attitude of investors toward risk and expected return. Therefore, in comparison to linear OLS models, which are based on the assumptions of constant mean and variance, autoregressive conditional heteroscadasticity (ARCH) models are advanced in forecasting conditional volatility of high frequency financial time series. Campbell and MacKinlay (1997) argue that it is both logically inconsistent and statistically inefficient to use volatility measures that are based on the assumption of constant volatility over some period when the resulting series moves through time. In the case of financial data, viz. stock returns, interest rates, inflation etc., the large and small errors tend to occur in clusters, i.e., large returns are followed by more large returns, and small returns by more small returns. In such case, ARCH models are widely applicable to forecast the volatility of series.

Moreover, as Bera and Higgins (1993) remarked that a major contribution of the ARCH literature is the finding that apparent changes in the volatility of economic time series may be predictable and result from a specific type of nonlinear dependence rather than exogenous structural changes in variables.

Against the above background, the purpose of this study is to analyze the persistence of shocks in IBR volatility in Nepal for daily and monthly interbank market. The ARCH and generalized ARCH (GARCH) methods have been applied to measure the volatility using high daily and monthly IBR series. The significance of applying ARCH family models are that they are simple and easy to handle, they take care of clustered errors, nonlinearities, and more appropriately forecast the high frequency time series. Therefore, an important application of ARCH and GARCH models are to measure and forecast the time-varying volatility of IBR, particularly data observed at high frequencies.

II. FACTORS AFFECTING VOLATILITY OF IBR

Volatility clustering is confirmed with the significant GARCH effect in monthly and daily IBR series. The variance is highly persistent and might have been driven by several factors.[2]

[2] This is based on the conclusion from analysis of later sections.

Interbank rate in Nepal is one of the market clearing rates. Fluctuations in the interbank rate arise mainly from supply and demand for liquidity in the money market. However, as the central bank is a monopolist in terms of supplying reserves, it can directly affect equilibrium. The demand and supply of liquidity position are affected through open market operations (OMO), foreign exchange interventions, refinance facility of central bank on one hand, and market forces, seasonal factors, commercial banks' cash requirements to meet their daily payment obligations and other factors like cash holding propensity of the people or expectations on the other. The factors influencing demand and supply conditions of bank reserves also influence the IBR, which are briefly discussed below.

Reserve Requirements: Banks are required to hold a percentage of reserves at Nepal Rastra Bank (NRB) as determined by the reserve ratio of deposit liabilities. The reserve requirement acts as a tool for liquidity management via two channels: reserve ratio and reserve maintenance period. Firstly, NRB, generally through monetary policy, may alter the liquidity position of the market through changing required reserve ratios.

Secondly, reserve maintenance period, is a provision for banks to comply with the reserve requirement over a given period on average. When the maintenance period is changed then the volatility of short-term interbank rates would likely to be change. In Nepal, cash reserve requirement is calculated as a proportion of average level of deposit liabilities held over a week, called reserve computation period. The calculated amount must be satisfied on average over a reserve maintenance period, which is also a week. The reserves maintenance period follows the reserves calculation period with two weeks lag.[3] On the other hand, statutory liquidity requirement are calculated on monthly average basis with lag in between calculation and maintenance period.

Hamilton (1996) and Prati and others (2001) observe that in most countries, interest rate volatility rises systematically through the reserve maintenance period, increasing as settlement day approaches. Prati & et.al. (2001) finds the length of these periods varies from country to country, with the U.S. averaging over a two week period, while Japan and the Euro zone average over a month. Shahiduzzaman & Naser (2007) state that in Bangladesh, reserve requirement is calculated as a portion of average level of deposits held over a month called reserve computation period; the calculated amount must be satisfied on average over a reserve maintenance period, which is the next fortnight.

However, in China reserve requirements should be maintained on a daily basis. A day to day maintenance of reserve makes the market more volatile. Bartolini and Prati (2003) and Moschitz (2004) find that by not averaging reserves over some maintenance period, this additional trading to either borrow sufficient funds or lend surplus funds is required every day, thereby resulting in higher average volatility.

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[3] See, Circular No. 13/067 in. Unified Directives of NRB for banks and financial institutions. Website: http://bfr.nrb.org.np/directives/Directives--Unified_Directives_%202067.pdf

***Foreign Exchange Intervention**:* All other factors remaining the same, foreign exchange market interventions affect the liquidity position of banking system. As central bank purchases foreign currencies of banks, their liquidity in terms of domestic currency increases.

Government Budget: The other fundamental factor affecting short-term liquidity position is the government budgetary management. Government spending injects liquidity; and taxes and domestic borrowing pull out liquidity from the market. Antal J. & et. al. (2001) states the "international practice is divided among countries over the issue of whether the treasury should hold its account exclusively with the central bank or with commercial banks (as well). Whereas in Germany, Austria, the Netherlands and Finland the volatility of treasury account balances held with the central banks is so low that their effect is negligible, in Italy and Spain it is quite large, especially at tax payment dates. Taken together, the volatility of treasury account balances is the item among the so-called autonomous factors which tends to affect interbank liquidity the most"(p.23).

Lending, Cash Holdings and Other Factors: The central bank may increase supply of liquidity by direct lending to banks. The NRB lends at pre-determined refinance rate to banks for loans to sick industries, export credit, and rural development banks. On the other hand sometimes unexpected events like change in propensity to cash holding and fear of people with the government's rule also affect the liquidity position in the banking system. Karki (2010) describes that in the fourth month, after the Dashani festival of 2009/10 liquidity declined and recorded a shortage of Rs. 1.9 billion because of the disappearance of higher denomination notes and interruption in supply chain management of NRB's note delivery. Similarly, due to the uncertainty regarding Voluntary Disclosure of Income Scheme (VDIS) and provision of Government of Nepal of disclosing income source for more than Rs. 1 million's transactions, people tended to hoard money themselves.

III. LIQUIDITY MANAGEMENT PRACTICE IN NEPAL

Nepal adopted a gradual liberalization policy since mid 1980s. Under the process of liberalization, the old NRB act is replaced by new Nepal Rastra Bank Act 2002, which provides independence to the central bank. Interest rate has been gradually liberalized[4]; controlled interest rate regime was completely abolished on August 31, 1989. In spite of the liberalization policy, considering the vulnerability to shocks bearing capacity of the economy, Nepal has adopted dual currency system – flexible exchange rate vis-à-vis convertible currency and fixed exchange rate with Indian currency.

The NRB Act, 2002 limits the objectives of monetary policy to maintain price, financial and external sector stability. The fixed exchange rate with Indian currency is a nominal

[4] Maskay and Pandit (2010) divides time line of interest rate liberalization in four phases: pre interest phase, pre 1955, controlled interest rate phase 1956-1983, transitional interest rate phase 1984-1989, liberalized phase 1990-present.

anchor of monetary policy. Excess liquidity of financial system is chosen as an operating target of monetary policy with monetary aggregates as intermediate targets.

As interest rates are fully liberalized in Nepal, the NRB signals its policy stance either through bank rate, cash reserve ratio (CRR), or open market operation. Policy signals are given through changes in the bank rate and CRR in the annual announcement of monetary policy. However, Maskay and Pandit (2010) examine the impact of bank rate on market interest rate using annual data and finds that the bank rate in Nepal is ineffective in influencing the market rates. On the other hand, the medium-term policy instruments including outright sale and purchase auction as well as short-term policy instruments repo and reverse repo auctions of treasury bills are active in offsetting imbalances in liquidity mismatch in open market operations.

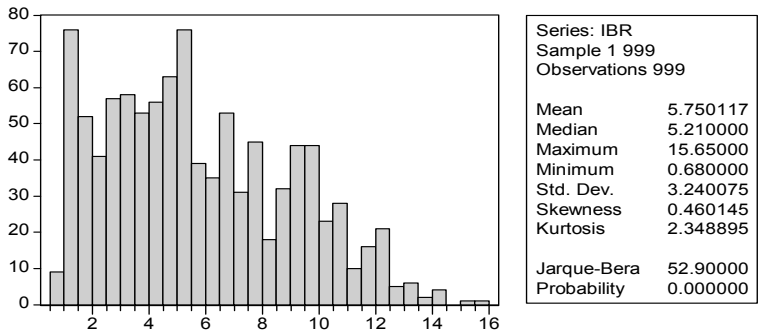
The Liquidity Monitoring and Forecast Framework (LMFF) has been made operational since fiscal year 2004/05. The LMFF supports open market operation (OMO) in order to monitor and forecast medium-term and short term (weekly) liquidity position of the economy. The quantity of outright sale or purchase and repo or reverse repo auctions in the secondary market is determined as per the recommendation of LMFF. Since fiscal year 2008/09 development banks and finance companies were also allowed to participate in open market operation (OMO)[5], which increased the horizon of the liquidity market.

Banks and finance companies approach interbank market if they need immediate overnight liquidity or use standing liquidity facility (SLF) of central bank. The SLF can be used maximum for 5-days; it is fully collateralized and limited to 90 % of the collateral value. However according to IMF (2008) few banks are largely using SLF which has made the central bank the lender of first rather than last resort. Due to this backdrop, SLF rate is determined adding 3 % as penal rate at interest rate on the latest weighted average 91-days treasury bills rate or prevailing bank rate, whichever is highest[6]. As interest rate of SLF is higher than the market rate, banks first approach for fund in the market, and use central bank as a source of last resort.

[5] Prior to this only commercial banks were the participant in OMO.
[6] See, NRB (2010)

IV. DATA AND DESCRIPTIVE STATISTICS

Figure-1 Descriptive Statistics of Inter Bank Rate (IBR)



The daily data of weighted average interbank rate (IBR)[7] has a significant difference between its minimum and maximum rates. The market average IBR for the study period is 5.75 percent. The standard deviation of IBR series is 56 percent of its mean. The distribution of the IBR in Nepali money markets is described by skewness. Positively skewed IBR indicates that it has relatively long right tail i.e., distribution has relatively few high values. This denotes that IBR distribution is non-symmetric. On the other hand, the kurtosis value 2.35 < 3 indicates that the distribution is platykurtic or relatively flat. The Jarque-Bera test firmly rejects normality implying that the daily IBR series is not normally distributed. Similarly, as depicted on Table 2 of Appendix 1, monthly IBR series shows that distribution is relatively peak. The Jarque-Bera test suggests that monthly IBR series is not normally distributed. The mean of monthly IBR is less than the mean of daily IBR.

V. INTERACTION OF IBR WITH REPO AND REVERSE REPO

Figure 2 shows interaction of daily weighted average interest rate (IBR), repo and reverse repo rate of Nepali financial markets. The repo and reverse repo rate are the rate determined by the auction system of the NRB under its open market operation. However, interbank rate is market determined rate. All three rates IBR, repo, and reverse repo rate follow the same trend. Interbank rate is high when repo rate is high. On the other hand, interbank rate is low when reverse repo rate is low.

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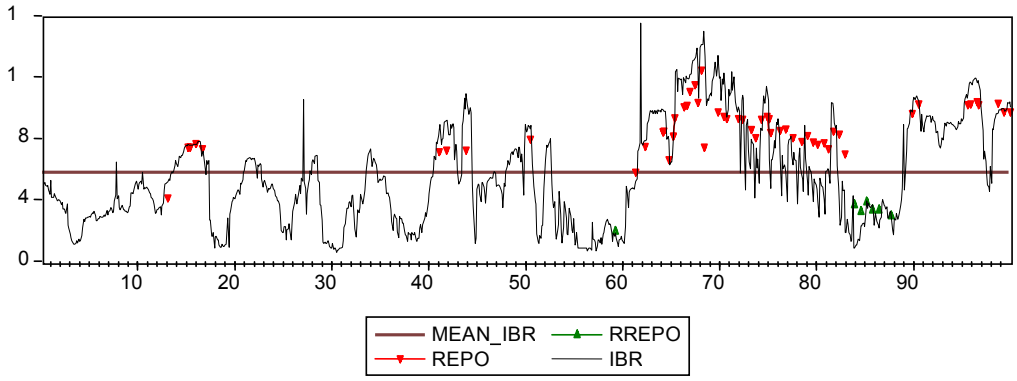
[7] IBR series is available at Nepal Rastra Bank website:
http://www.nrb.org.np/cmfmrates_details.php?search=02
Note :Out of 999 observations, the missing 26 sample units are interpolated

Figure 2: Graphical Presentations of IBR, Repo and Reverse Repo Rate



However, as show in Figure 2, repo and reverse repo may have lag effect on interbank rate. Interbank rate decreases after the introduction of repo and increases after the introduction of reverse repo. Introduction of repo by the NRB increases the supply of liquidity, which in turn, eases the demand-supply gap for liquidity and drives IBR to fall. On the other hand, reverse repo mop ups the liquidity which tends to increase the interbank rate. In addition, there are factors like government spending, seasonal factors, festivals etc. that also force IBR to rise or fall. The fluctuation of IBR depicts that the interbank rate in Nepal is volatile.

VI. METHODOLOGICAL FRAMEWORK

Engle (1982) invented the autoregressive conditional heteroscedasticity (ARCH) model to examine volatility of inflation of United Kingdom. However, besides inflation, the model has become an important econometric tool to measure the variability or volatility of all the time series data. Green (2005) states that the ARCH model has proven to be useful in studying the volatility of inflation, the term structure of interest rates, the volatility of stock market returns, and the behavior of stock market returns, and the behavior of foreign exchange markets, to name but a few. Since its development, various extensions or modifications have been made in the ARCH model and named as GARCH, generalized autoregressive conditional heteroscedasticity, IGARCH, integrated generalized autoregressive conditional heteroscedasticity, ARCH-M, autoregressive conditional heteroscedasticity in mean etc.. These models are widely used in economic and financial time series to model the volatility.

The two most popular models of volatility clustering are ARCH and GARCH. Suppose that the autoregressive distributed lag, ADL (p, q), regression

$$Y_t = \beta_0 + \Sigma \beta_j Y_{t-j} + \Sigma \gamma_k X_{t-k} + u_t.$$

where Y_t and X_t are the variables , β_0 is a constant and β_p and γ_q are the coefficients, j = 1,…,j and k = 1, … ,k are the number of lags, and u_t is the error term. In the ARCH model the error term is modeled as being normally distributed with mean zero and variance σ_t^2, where σ_t^2 depends on past squared values u_t. Specifically, the ARCH model of order p, denoted as ARCH (p), is

$$\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \alpha_2 u_{t-2}^2 + \ldots\ldots\ldots + \alpha_p u_{t-p}^2$$

Where α_0, α_1 , α_2, …….. , α_p are unknown coefficients.

In the ARCH (p) process for unconditional variances to be finite and non-negative and satisfy the conditions of $\alpha_0 \geq 0$, $\alpha_i \geq 0$, and $0 \leq \sum \alpha_i \leq 1$ for all i = 1, …, p. Patterson (2002) explains that "testing for an ARCH (p) process is usually done with Langrarian Multiplier (LM) principle and rejection of null hypothesis in favor of ARCH (p) with p 'large', rule of thumb $p \geq 3$, is suggestive of a GARCH process" (p. 742).

The generalized ARCH (**GARCH**) model extends the ARCH model to let σ_t^2 depend on its own lags as well as squared error. The GARCH (p, q) model is

$$\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \ldots\ldots\ldots + \alpha_p u_{t-p}^2 + \phi_1 \sigma_{t-1}^2 + \ldots\ldots\ldots + \phi_q \sigma_{t-q}^2$$

Where α_0, α_1, …….. α_p , ϕ_1, ϕ_2..…….. ϕ_p are unknown coefficients.

In the GARCH (p, q) process the conditions of $\alpha_0 \geq 0$, ϕ_j and $\alpha_i \geq 0$, and $0 \leq \sum \alpha_i + \sum \phi_j < 1$ for all i = 1, …, p, and j = 1, …,q must be satisfied.

Moreover, in widely applied GARCH (1, 1) model, $\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \phi_1 \sigma_{t-1}$, estimations sometimes result in $(\alpha_1 + \phi_1) \approx 1$ or even $(\alpha_1 + \phi_1) > 1$. Engle and Bollerslev (1986) show that if $(\alpha_1 + \phi_1) \geq 1$, the conditional variance is persistent to the shocks. Similar to standard unit root process when $(\alpha_1 + \phi_1) \geq 1$ the GARCH (p, q) model is said to be integrated. This model, first developed by Engle and Bollerslev, is referred to an Integrated GARCH model, or an IGARCH model. Squared shocks are persistent, so the variance follows a random walk with a drift.

However, Nelson (1990) points out that the analogy with a random walk is not precise. He shows that even in IGARCH process the conditional variance is a geometrically decaying function of the current and past realizations of the u_t^2 sequence. As such, an IGARCH model can be estimated like any other GARCH model.

The GARCH model contains mean and variance equations, where the model of mean can contain explanatory variables. In addition, the specification of variance equation also allows for exogenous and dummy variables (D_t).[8] Therefore, GARCH (1,1) specification can be modified as

$$\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \phi_1 \sigma_{t-1}^2 + \lambda D_t$$

If it is found that $\lambda > 0$, it is possible to conclude that the shocks has increased the mean of conditional volatility.

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[8] See, Enders W. (2004), p.141 on the topic "Models with Explanatory Variables "

Therefore, with an application of ARCH and GARCH models this study concentrates in identifying the incidence of shocks and its persistence.

VII. EMPIRICAL ESTIMATES

The empirical analysis has been done using daily and monthly weighted average IBR. The daily IBR series includes 999 observations over the period of 17 July 2007 to 28 February 2011 and monthly IBR series includes 192 observations over the period February 1995 to January 2011[9].

GARCH Model of Daily IBR

The ARCH(3), GARCH (1,1) with dummy and GARCH (1,1) without dummy in the variance equations are estimated for the IBR series to measure the conditional volatility.

The daily IBR series indicates volatility clustering and time-varying characteristics of volatility. The last two columns reported in the correlogram shown in Table 2 of Appendix 1 are the Ljung-Box Q-statistics and their p-values. The Q-statistic at lag k (lag length) is a test statistic for the null hypothesis that there is no autocorrelation up to order k. The values of Q statistics, ACF and PACF suggest the presence of autocorrelation and hence volatility clustering in the IBR series. They continue to decrease with the increase in the number of lags. The autocorrelation in the series dies out after 82 lags. The correlogram of the IBR series suggests the evidence of ARCH effects judging from the significant autocorrelation coefficients. In nutshell, the properties of IBR series are consistent with other financial times series; this indicates that interbank rate of Nepal is non-normal and exhibits 'ARCH effect'.

A test for the presence of ARCH in the residuals is calculated regressing the squared residuals on a constant and p lags. The correct number of lags in the model has been selected by using the sign of coefficients, AIC and SIC information criterion. The test can also be thought of as a test for autocorrelation in the squared residuals. The estimates and test-statistics of ARCH (3) model in Table 3 of Appendix 1 depicts the ARCH in IBR series.[10] The non-negativity constraints of the coefficients have not been violated. ARCH models provide a framework for the analysis and development of time series models of volatility. However, the sum of ARCH coefficients in ARCH (3) exceeds unity; it indicates the high persistence of shocks in volatility of IBR.

Most recent empirical studies use GARCH model than ARCH as it is more parsimonious and avoids over-fitting. As stated earlier, ARCH (p) with p 'large', rule of thumb $p \geq 3$, is suggestive of a GARCH process.

The results of estimation and statistical verification of the GARCH (1, 1) with and without dummy variable are respectively shown in column third and fourth of Table 2 of

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[9] The difference in period for monthly and daily is because daily IBR is unavailable since 1995.

[10] E-Views 4.1 software has been used to estimate all the test-statistics and equations.

Appendix I. The AR (1) parameters in the mean equation are significant in both the estimated models. The constant and coefficient of GARCH (1, 1) terms of variance equation of both equations are positive and significant. In addition, coefficients of dummy variables are positive in the variance equation of GARCH (1, 1) with dummy model.[11]

The sum of ARCH and GARCH coefficients ($\alpha_1 + \phi_1$) = 1.23, which is greater than one, in GARCH (1, 1) model. As suggested by Engle and Bollerslev (1986) the conditional variance is highly persistent to the shocks; so, memory of shocks is remembered in the interbank liquidity market. On the other hand, the sum of ARCH and GARCH coefficients ($\alpha_1 + \phi_1$) = 0.63, in GARCH (1, 1) model with dummy variable indicates that the variance is relatively less persistent to the shocks as result of the repo and SLF in the liquidity market. However, the significant coefficients of dummies depict that the repo and SLF has increased the mean conditional volatility.

Interbank liquidity market of Nepal is volatile with high degree of persistence to the shocks, which has long memory in volatility. However, the open market operation of NRB has been very effective to decrease the long memory of shocks but has increased the mean of conditional variances.

Figure 3: GARCH Variances With and Without Dummy

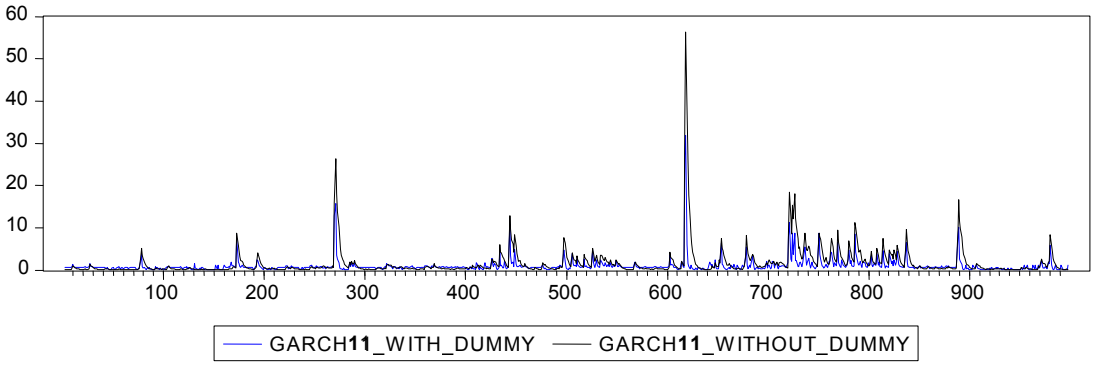


Figure 3 depicts the estimated GARCH variances of interbank rate of Nepal during the period 17 July, 2007 to 28 February, 2011. The series exhibits volatility clustering and time-varying characteristics of volatility. There is duration of time where the volatility is relatively high and relatively low which indicates volatility clustering during the study period. Statistically, volatility clustering implies a strong autocorrelation in the IBR series. Volatility clustering describes the tendency of large changes in interbank rate to follow large changes and vice versa. In other words, the current level of volatility tends to

[11] Two dummy variables are used which takes value 1 and 0 based on whether there is repo and SLF or not.

be positively correlated with the preceding periods. The conditional volatility in interbank liquidity market has increased in recent periods, and relatively high volatile in the middle, and relatively low in earlier sample period.

GARCH Model of Monthly IBR

The GARCH (1, 1) in the variance equations are estimated for the monthly IBR series to analyze the conditional volatility. The GARCH variance series shows the volatility clustering and time-varying characteristics of volatility.

The correlogram shown in Table 4 of Appendix 1 suggests the presence of autocorrelation and hence volatility clustering in the monthly IBR series. They continue to decrease with the increase in the number of lags, where the autocorrelation in the series dies out after 14 lags. Similar to other financial series, monthly IBR is non-normal and exhibits 'ARCH effect'.

The estimates and test-statistics of ARCH (2) model of monthly IBR is shown in second column of Table 6 in Appendix 1. The non-negative coefficients of ARCH models suggest volatility. However, the sum of ARCH coefficients in ARCH (2) is 0.76 <1 shows persistence of shocks in volatility of monthly IBR series.

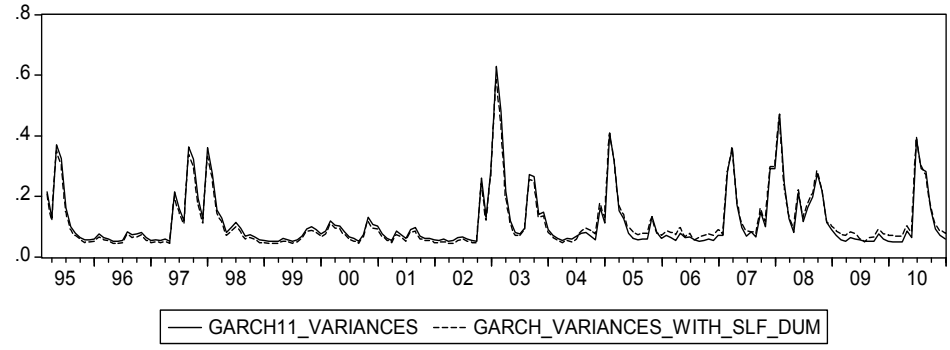
The estimates and statistical verification of the GARCH (1, 1), effect of SLF, and joint effect of repo and reverse repo on conditional variance are respectively shown in third, fourth and fifth column in Table 6 of Appendix 1. The AR (1) and constant parameters in the mean equation are significant in all estimated models. Similarly, the constant and coefficients of GARCH (1, 1) of variance equations are positive and significant in all the estimations. In addition, coefficient of SLF dummy (SLF_d) is positive and significant at 10 percent level of significance. However, the dummy coefficients of repo (repo_d) and reverse repo (rrepo_d) are insignificant even at 10 percent level of significance.

The sum of ARCH and GARCH coefficients ($\alpha_1 + \phi_1$) in the GARCH (1, 1) model with and without SLF dummy are respectively 0.76 and 0.74. During the sample period, SLF facility of NRB to banks has marginally decreased the persistence of shocks to IBR volatility.

Monthly weighted average interbank rate is volatile in Nepal. As the sum of GARCH coefficient is 0.76 i.e., less than unity, the effect of shocks to conditional volatility market dies out, but slowly. Figure 4 depicts the estimated GARCH variances of monthly IBR of Nepal during the period 1995 February to 2011 January. Similar to daily IBR series,

monthly series also exhibits volatility clustering and time-varying characteristics of volatility. There is duration of time where the volatility is relatively high and relatively

Fig 4: GARCH Variances With and Without SLF Dummy



low. The conditional volatility in interbank liquidity market is relatively high at the end of 2010.

Fig 5: GARCH(1,1) Variances By Month: 1995 Feb - 2011 Jan

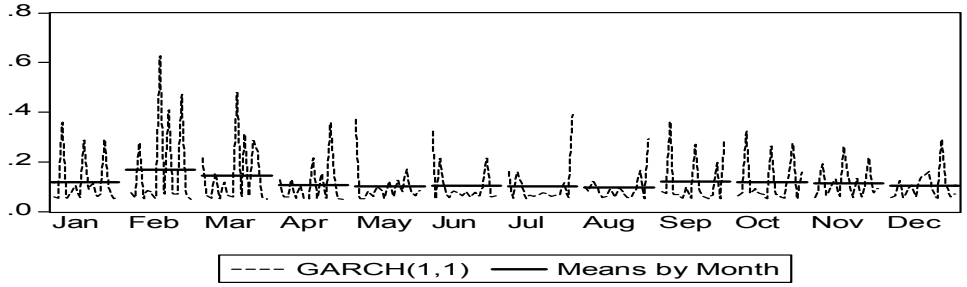


Figure 5 shows monthly average of GARCH variances. It indicates that interbank liquidity market is highly volatility during February and less volatile during August.

VIII. CONCLUSION

The study finds that the distribution of inter bank rate is non-normal and exhibiting significant time dependencies. The conditional volatility of IBR series has been modeled using ARCH (p) and GARCH (1, 1) model. The study shows that the IBR series depicts the evidences such as volatility clustering, time-varying conditional heteroskedasticity. The sum of ARCH and GARCH coefficients are higher, when there is no exogenous variable in the variance equation.

The parameter estimates suggest that volatility shocks are highly persistent in interbank market as the sum of ARCH and GARCH coefficients are greater than unity in daily IBR series. However, it is less than unity when the effect of repo and SLF are taken into

account. It depicts that NRB's intervention has been effective to lower the persistence of shocks on conditional volatility, but it has increased the mean of conditional volatility as the coefficient of dummy variable is significant. The monthly analysis of volatility in interbank market suggests seasonal effect in the volatility. The mean of conditional variances is highest in February and lowest in August.

In nutshell, the study revealed strong evidence of time-varying volatility; a tendency of the periods of high and low volatility to cluster; and high persistence of shocks on volatility of interbank lending market. Lastly, the study suggests that still there is room for in-depth analysis to measure the impact of reserve calculation period, day-wise effect, government spending, taxes, and external sector on volatility of interbank market.

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Appendix-1

Table 1

Descriptive Statistics of Daily IBR

Mean	5.75
Median	5.21
Maximum	15.65
Minimum	0.68
Std. Dev.	3.24
Skewness	0.46
Kurtosis	2.35
Jarque-Bera	52.90
Probability	0.00
Sum	5744.40
Sum Sq. Dev.	10477.00
Observations	999

Table 2

Autocorrelation Function of Daily IBR

Autocorrelation	Partial Correlation	Lags	AC	PAC	Q-Stat	Prob
.|******* |	.|******* |	1	0.954	0.954	912	0.00
.|***** |	.|* |	10	0.709	0.073	6878	0.00
.|**** |	.| |	20	0.545	0.003	10808	0.00
.|*** |	.| |	30	0.413	-0.027	13085	0.00
.|*** |	*| |	40	0.331	-0.066	14481	0.00
.|** |	.| |	50	0.271	0.045	15374	0.00
.|** |	.| |	60	0.214	-0.034	15964	0.00
.|* |	.| |	70	0.124	-0.056	16290	0.00
.| |	.| |	80	0.016	-0.032	16333	0.00
.| |	.| |	82	0.003	0.033	16333	0.00
.| |	.| |	83	-0.002	-0.019	16333	0.00

Table 3

Modeling Conditional Volatility of Daily IBR

Dependent Variable: Inter Bank Rate (IBR)

Mean Equations			
	ARCH(3)	**GARCH(1,1)**	**GARCH(1,1) With Dummy**
C	**6.3217***	**6.3848***	**11.1218***
AR(1)	**0.9863***	**0.9883***	**0.9855***
Variance Equations			
C	**0.2475***	**0.0171***	**0.0781***
ARCH(1)	**0.6332***	**0.5518***	**0.4453***
ARCH(2)	**0.3002***	-	-
ARCH(3)	**0.3727***	-	-
GARCH(1)	-	**0.6783***	**0.1852***
REPO_DUM	-	-	**1.0931***
SLF_DUM1	-	-	**0.4149***
R-Squared	**0.9111**	**0.911**	**0.9107**
Adjusted R-squared	**0.9107**	**0.9107**	**0.9102**
S.E. of Regression	**0.9687**	**0.9689**	**0.9717**
Sum Squared Resid	**930.87**	**932.17**	**935.64**
Log Likelihood	**-1224.97**	**-1182.44**	**-1177.05**
Durbin-Watson Stat	**2.3027**	**2.304**	**2.289**
Mean Dependent Var	**5.7507**	**5.7507**	**5.7507**
S.D. Dependent var	**3.2416**	**3.2416**	**3.2416**
Akaike Info Criterion	**2.4669**	**2.3796**	**2.3728**
Schwarz Criterion	**2.4964**	**2.4042**	**2.4073**
F-Statistic	**2034.56***	**2541.86***	**1684.28***

Table 4
Descriptive Statistics of Monthly IBR

Mean	1.962
Median	1.760
Maximum	4.500
Minimum	0.600
Std. Dev.	0.859
Skewness	0.912
Kurtosis	3.156
Jarque-Bera	26.833
Probability	0.000
Sum	376.773
Sum Sq. Dev.	140.959
Observations	192

Table 5
Autocorrelation Function of Monthly IBR

Autocorrelation	Partial Correlation	Lags	AC	PAC	Q-Stat	Prob
.|******* |	.|******* |	1	0.916	0.916	163.66	0.00
.|***** |	.|* |	2	0.847	0.046	304.17	0.00
.|**** |	.| |	8	0.385	-0.065	725.1	0.00
.|*** |	.| |	9	0.32	0.01	745.9	0.00
.|*** |	*| |	10	0.255	-0.051	759.2	0.00
.|** |	.| |	11	0.201	0.014	767.51	0.00
.|** |	.| |	12	0.129	-0.166	770.93	0.00
.|* |	.| |	13	0.066	-0.006	771.84	0.00
.| |	.| |	14	0.015	0.003	771.89	0.00
.| |	.| |	15	-0.013	0.131	771.93	0.00
.| |	.| |	16	-0.053	-0.095	772.53	0.00

Table 6
Conditional Volatility of Monthly IBR

Dependent Variable: Monthly IBR				
Mean Equations				
	ARCH(2)	GARCH(1,1)	GARCH(1,1) With SLF Dummy	GARCH(1,1) With repo & rrepo Dummy
C	1.537*	1.553*	1.513*	1.523*
AR(1)	0.911*	0.914*	0.919*	0.92*
Variance Equations				
C	0.041*	0.029*	0.024*	0.024*
ARCH(1)	0.302**	0.368*	0.347**	0.346*
ARCH(2)	0.459*			
GARCH(1)		0.392*	0.397*	0.42*
REPO_D				0.018
RREPO_D				0.012
SLF_D			0.016***	
R-squared	0.85	0.85	0.85	0.85
Adjusted R-squared	0.84	0.85	0.84	0.84
S.E. of regression	0.34	0.34	0.34	0.34
Sum squared resid	21.22	21.19	21.2	21.19
Log likelihood	-41.52	-44.71	-43.68	-43.9
Durbin-Watson stat	2.08	2.09	2.1	2.11
Mean dependent var	1.96	1.96	1.96	1.96
S.D. dependent var	0.86	0.86	0.86	0.86
Akaike info criterion	0.49	0.52	0.52	0.53
Schwarz criterion	0.57	0.61	0.62	0.65
F-statistic	259.75*	260.18*	206.96*	171.65*

Note: **, **and *** respectively represents significant at 1% , 5% and 10 level of significance*

An Empirical Analysis of Money Demand Function in Nepal

Birendra Bahadur Budha*

Abstract

This paper analyzes the money demand function for Nepal during the period of the FY 1997/98 to FY 2009/10 using annual data. The empirical results imply that the cointegration tests clearly show the existence of the long-run relationship between real money balances and its determinants, output and interest rate. The vector error correction model has proved the short-run relationship between the real money balances and its determinants. Furthermore, Dynamic OLS estimation of the money demand function indicate that the sign of coefficients of the output and interest rate were found to be consistent with the assumption of the money demand theories.

I. INTRODUCTION

The study of a money demand function is a prime issue since the stable money demand function is prerequisite for the conduct of the effective monetary policy. The demand function for money helps to ascertain the liquidity needs of the economy (Handa, 2009). As a result, it is exigent for the policy makers to understand the factors that determine this function and the existence of a stable long-run relationship between these factors and the money stock. This pivotal role of the money demand function has generated many empirical researches related to the money demand function, including its long-run and short-run stability. Despite the fact that there is a great deal of studies on the money demand in both developed and developing countries, no in-depth study, to our knowledge, has been reported yet on this subject for Nepal. Taking this fact into consideration, this paper tries to fill the gap in the literature by estimating the money demand function for Nepal.

The main objective of this paper is to estimate a theoretically consistent model of the money demand function of Nepal for the period of FY 1997/98 to FY 2009/10 using annual data. Two different definitions of money balances have been employed in the study: narrow money (M1) which includes currency and demand deposits, and broad money (M2) which includes M1 and time deposits. For the model estimation, this paper

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Remarks: The views expressed in this paper are those of the author and do not necessarily represent those of the Nepal Rastra Bank.

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employed the method of cointegration, error correction model (ECM) and Dynamic ordinary least squares (DOLS).

The current monetary policy framework of Nepal has taken broad money as the interim target of the monetary policy (NRB, 2010). Furthermore, several noticeable changes have been occurred in the Nepalese financial system and the economy as a whole after the implementation of the financial sector reform program. In this type of economic milieu, this study bears significance for policy makers, especially Nepal Rastra Bank in its future policy making.

The brief outline of this paper is as follows. Section **II** deals with methodology, which includes models, data features and model estimation technique. Section **III** presents the empirical results of the study and analysis of the results. Section **IV** includes the conclusion and provides the policy implications of the findings.

II. MODELS AND DATA

Data and Their Features

This paper uses annual data of Nepal over the period of FY 1997/98 to FY 2009/10 for empirical analysis. Data include broad money (M1), narrow money (M2), the urban consumer price index (CPI), nominal GDP, the interest rate and real GDP. The sources of data include Nepal Rastra Bank's annual reports and quarterly economic bulletins, and various issues of *Economic Survey of Ministry of Finance*, Nepal. The data source of M1 and M2 are the various issues of the *Quarterly Economic Bulletin* of NRB. The interest rate at the savings deposit at commercial banks has been used as the interest rate for the empirical analysis.[1] Due to the unavailability of the data on weightage rate, this study utilized the interest rate calculated by taking the average of the upper and lower limit of the structure of the interest rate for each year. Data on interest rate were obtained from the various issues of *Quarterly Economic Bulletin* of NRB bulletin. Data on GDP and CPI were obtained from the various issues of *Economic Survey* of Ministry of Finance (MOF), Nepal. The nominal values were deflated by using CPI in order to compute the real values. Logarithm values are used for money supply, price levels and output (GDP). Interest rates are analyzed in two ways, taking a logarithm in one case and not in the other.

[1] Near money assets such as savings deposits in commercial banks proved to be the closest substitutes for M1, so that their rate of return seems to be the most appropriate variable for the cost of using M1. But, if the broader definition of money were used, the interest rate on medium-term or long-term bonds would become most appropriate (the alternative to holding M2 or M3 is longer term bonds), since savings components of the broad definition of money themselves earn an interest rate close to the short rate of interest (Handa, 2009).

Econometric Models

There are various theories concerning the money demand function. There is generally a consensus among the money demand theories that the main determinants of the quantity of money demand are the scale variable, which can be real income, wealth, or permanent income and opportunity cost variables. For example, Kimbrough (1986a, 1986b) and Faig (1988) came up with the following money demand function as a result of explicitly considering transaction costs:

$$\frac{M_t}{P_t} = L(Y_t, R_t) \qquad L_Y>0 \ , L_R<0 \ldots\ldots\ldots\ldots\ldots(1)$$

In this function, M_t represents nominal money supply for period t; P_t represents the price index for period t; Y_t represents output for period t; and R_t represents the nominal interest rate for period t. Increase in output lead to increase in money demand, and increase in interest rates lead to decreases in money demand. The function L is assumed to be increasing in Y_t, decreasing in those elements of R_t representing rates of return on alternative assets, and increasing in rates of return associated with assets included in M_t. Income, GDP in this model, is the choice of the scale variable because of the data limitation on wealth. The opportunity cost of holding money i.e the rate of interest is the second independent variable that determines the money demand function. Therefore, the proposed money demand function for Nepal specified in a log-linear form corresponding to equation (1) in order to conduct an empirical analysis are:

Model 1: $\ln(M_t) - \ln(P_t) = \beta_0 + \beta_1 \ln(Y_t) + \beta_2 R_t + \mu_t, \quad \beta_1>0, \beta_2<0$ ……..(2)

Model 2: $\ln(M_t) - \ln(P_t) = \beta_0 + \beta_1 \ln(Y_t) + \beta_2 \ln(R_t) + \mu_t, \quad \beta_1>0, \beta_2<0$……..(3)

Where, β_1 in both equations (2) and (3) is the income elasticity of money demand, but β_2 in (2) is the semi-elasticity of money demand with respect to interest rate and in (3) is the elasticity of money demand with respect to interest rate.[2] The positive sign is expected for income coefficient, while the domestic interest rate coefficient is expected to be negative. Both models 1 and 2 are log linear models, but Model 1 uses the level of interest rates and model 2 uses the logarithm value of interest rates. Model 1 is conventional form of the money demand function mostly used in the empirical research whereas Model 2 is based on the inventory-theoretic approach to money demand pioneered by Allias (1947), Baumel (1952) and Tobin (1956).

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[2] Semi-elasticity used in model 1 shows by how much percent real money demand change in response to a change in the interest rate of 1 percentage point (that is, for instance, the rate rising from 5% to 6%). It can be defined as:

$$\beta_2 = \frac{d \ln M}{dR} = \frac{dM/M}{dR}$$

The elasticity (such as β_1 in model 1 and β_1 and β_2 in model 2) shows how the demand for money changes in response to a given percentage point change in the interest rate (say a one percentage point change from 5.0% to 5.05%).

Model Estimation

As a preliminary analysis, the augmented Dickey-Fuller test is carried out for the logs of real money balances, GDP, and interest rates (Dickey and Fuller, 1979). ADF test is one of the unit root tests to determine whether each data series is non-stationary (that is unit root exist) or stationary (unit root do not exist).[3] This test forms the preamble to the econometric analysis of long-run equilibrium proposed by economic theory. Stationarity of the series is a desirable property for an estimated model. A stochastic process is said to be stationary if its mean and variance are constant over time and the value of the covariance between the two time periods depends only on the distance or gap or lag between the two time periods and not the actual time at which the covariance is computed (Gujarati, 2007). Then, this work uses the widely used method of cointegration and error correction technique in the framework of the linear multivariate vector autoregressive (VAR). A testing procedure suggested by Johansen and Juselius (1990) is conducted to examine possible cointegration among the variables. The Johansen technique provided maximum-likelihood estimates for testing more than one cointegrating vector in a set of time series. This technique is set to account for long-run properties as well as short-run dynamics, in the framework of multivariate vector autoregressive models (Alsahafi, 2009). If the variables that have unit roots are cointegrated, it is appropriate to estimate Vector Error Correction Models (VECM). The VECMs are designed for use with nonstationary series that are cointegrated (Hamilton, 1994). Therefore, this study makes use of VEC models to analyze the money demand.[4] The VECM approach has the

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[3] An Augmented Dickey-Fuller test can be specified as:

$$\Delta y_t = \mu + \eta t + \gamma^* y_{t-1} + \sum_{j=1}^{p-1} \phi_j \Delta y_{t-j} + \varepsilon_t$$

Where y_t is a random variable possibly with non zero mean, μ is a constant, t time trend and ε_t is a error correction term with zero mean and a constant variance. The null hypothesis of the unit root (γ^* =1) is tested against the alternative of stationarity using critical values provided by MacKinnon distribution (Greene, 2002).

[4] The VECM representation is :

$$\Delta y_t = \sum_{i=1}^{k-1} \Gamma_i \Delta y_{t-1} + \Pi y_{t-k} + \mu + \Psi D_t + \varepsilon_t$$

Where, $\sum_{i=1}^{k-1} \Gamma_i \Delta y_{t-1}$ and Πy_{t-k} are vector autoregressive (VAR) components in the first differences and error correction components in level, respectively. Y_t is px1 vector of the variables that are integrated of the same order. μ is a px1 vector of constants. K is a lag structure, while ε_t is px1 stationary random process with zero mean and constant variance. Γ_i is a p χ p matrix that represents short-run adjustments among variables. Π is decomposed into $\beta\alpha$, where β is an r χ p matrix of cointegrating vectors and α is an p χ r matrix of the speed of adjustments (Alsahifi, 2009).

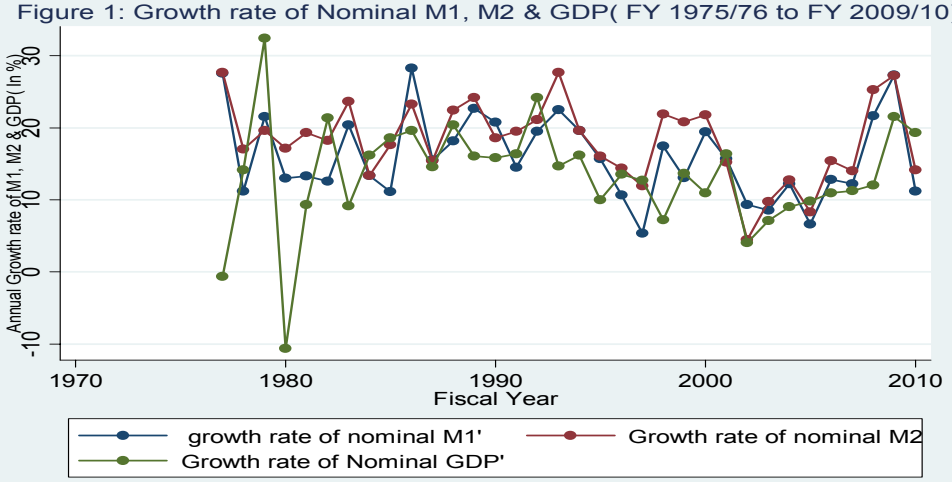
advantage of jointly estimating the long- and short-run components of the demand for money, thus facilitating the task of ensuring that short-run specifications are associated with long-run components with established economic theory (Alsahafi, 2009). Finally, the Dynamic OLS (DOLS) developed by Stock and Watson (1993) has been employed in order to estimate the coefficients of the both models (2) and (3).

III. EMPIRICAL RESULTS AND ANALYSIS

Growth and Velocity of Monetary Aggregates

One of the simple approaches for analyzing the relationship between money and the economy is to examine their graphical relationship and properties. The figures presented show simply the annual growth rates of the money balances and GDP, and income velocity of the money (VM) balances both in nominal and real terms. Figure 1 shows the historical development of the nominal money balances (M1 &M2) and GDP of Nepal during FY 1975/76 to FY 2009/10.

Figure 1: Growth rate of Nominal M1, M2 & GDP(FY 1975/76 to FY 2009/10)



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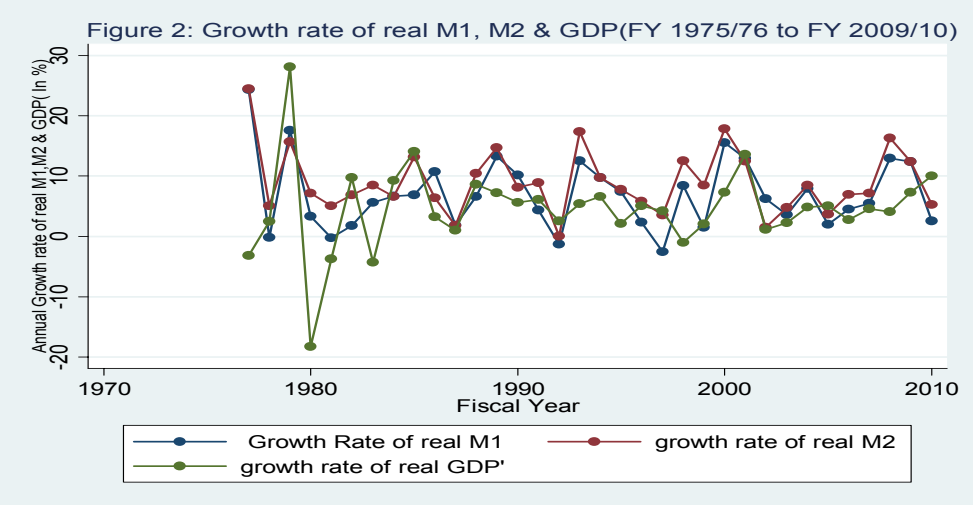

Similarly, Figure 2 shows the growth of the real GDP, M1 and M2. The figures clearly show that the changes in the nominal money balances have been closely associated with the changes in economic activity as represented by GDP. During the study period, the growth rates in both nominal (Figure 1) and real terms (Figure 2) money supply have also fluctuated and nearly captured the major up (for example, FY 1985/86) and downswings (for example, FY 1995/96) of the economy.

The income velocity of money (VM) also plays the important role in ensuring the effectiveness of the monetary policy since when VM is unpredictable, money demand function is also unstable.[5] Figure 3 and 4 show the income velocity of money for both M1 and M2 of Nepal for the period of FY 1975/76 to FY 2009/10. The velocity of both M1 and M2 in nominal and real terms has been declining gradually, but along with the fluctuation in few years. The velocity of the M1 has been more fluctuating than the M2 in the study period. The velocity of M1 became more stable after FY 1999/00 whereas it fluctuated continuously before this time period. It is clear from the figures presented above that the VM of M2 seem to be relatively more stable than the VM of M1 in both real and nominal terms.

[5] VM is defined as the average number of times that a national currency is spent in a year. Hence, it can be defined as the ratio of GDP to money supply i.e $VM = \frac{Y}{M}$, where Y stands for GDP and M stands for money supply.

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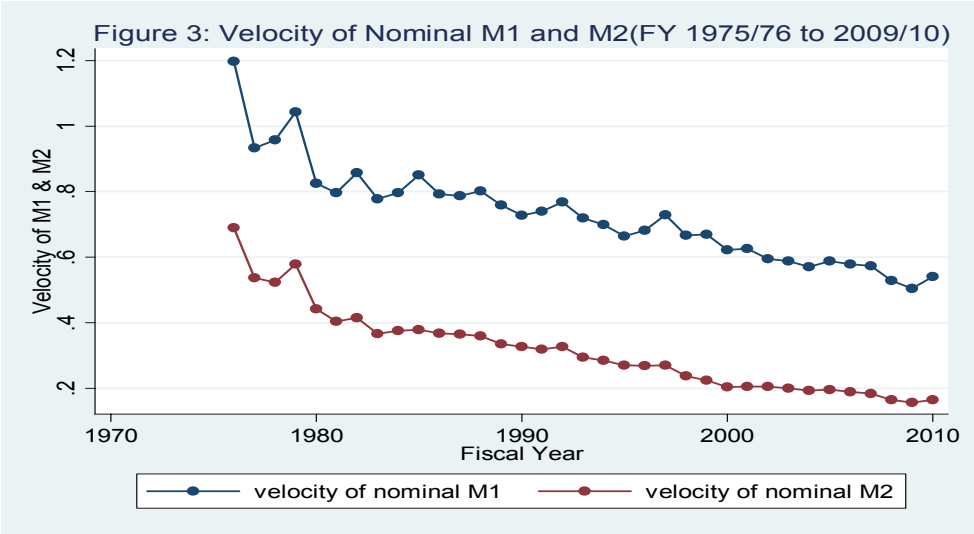

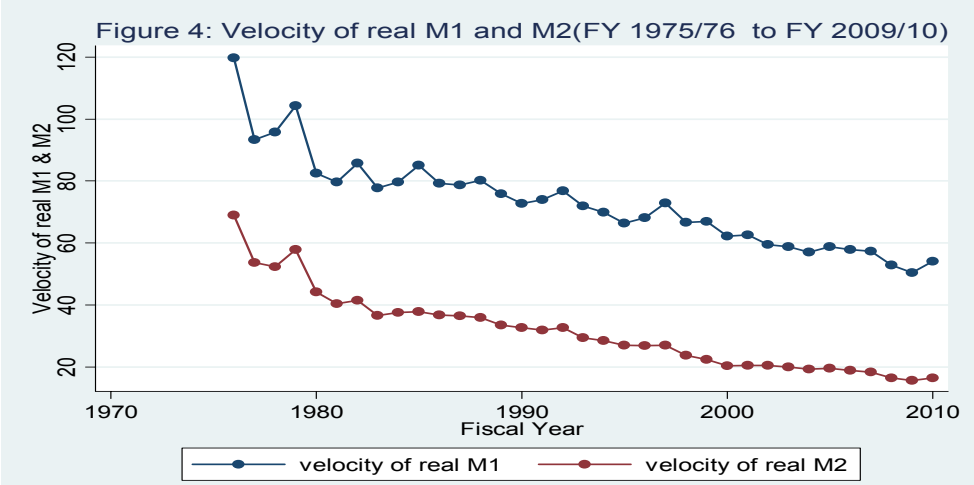

The declining value of VM of Nepal implies the increase in the degree of the monetization of the economy. Furthermore, the decline in VM has partly offset the inflationary potential of the growth in the money supply.

Unit Root Test Results

Before embarking upon the cointegration analysis, the time series properties of the variables need to be examined. For this, this study makes use of the Augmented Dickey-Fuller (ADF) test in a regression with a drift, but no trend to analyze the time series

properties of the data. Table 1 presents the estimated test statistics for all variables on the level and first difference using ADF.

Table 1: Augmented Dickey-Fuller (ADF) Test

Variables	Augmented Dickey Fuller(ADF)	
	Levels	First Difference
LRGDP	-0.288	-2.897**
LRM1	-1.320	-3.036*
LRM2	-0.629	-3.374*
LP	-0.134	-2.344**
R	-0.134	-1.177

Notes: 1.LRGDP, LRM1, LRM2, LP and R are the log of the real GDP, real M1, real M2, CPI and nominal interest rate respectively.
2. */** stand for significant at 1% and 5%, respectively.
3. Critical values were used of Mackinnon (1991). The critical values are -2.99 and -1.89 at the 1% and 5% level of significance respectively.

The statistics under ADF tests implies that all levels of the natural logarithms of the mentioned time series variables have unit roots at the 5 per cent level of significance. Furthermore, the ADF statistics show that the unit root hypotheses are rejected at the 5 per cent level of significance for the first difference of the natural logarithms of the variables except R. As a result, the ADF test conducted implies that the level of each variable was found to have a unit root, whereas the first difference of each variable was found not to have a unit root except R. Thus, all variables are found to be non-stationary at levels and stationary at their first differences except R. All variables are best modeled as I (1) with drift. Since almost variables are integrated of the order I(1) with drift, then one can expect that these series may be cointegrated as well.

Cointegration Analysis

This paper has used the Johansen and Juselius(1990) methodology to test the presence of a stable long-run relationship between real money balances and their determinants. Johansen and Juselius (1990) use both trace eigenvalue statistics(λ_{trace}) and maximum eigenvalue statistics(λ_{max}) which are employed to determine the cointegration vectors. The optimal lag length of VAR is determined by the Sequential Likelihood Ratio (LR), the Final Prediction Error (FPE), and the Akaike Information Criterion (AIC). Table 2 presents the results of the rank tests of the M1. The result reported from the trace and maximum eigenvalue statistics show that the null hypothesis of the cointegrating vector linking real M1 and its determinants is rejected at the 5% level of significance for both λ_{max} and λ_{trace} statistics for both models 1 and 2 since λ_{max} and λ_{trace} exceed their corresponding 5% critical values. In model 1, however, for $\lambda_{max,}$ the null hypothesis of the, at most, one cointegrating vector cannot be rejected at the 5% significance level. It is obvious that both statistics yield different results. But Johansen and Juselius(1990) suggest the use of λ_{trace} statistics in the situation of the conflict between the two statistics. As a result, we can conclude that there exist more than one cointegrating vectors for this M1 at the 5% significance level if we consider model 1. In model 2, the null hypothesis of

the zero cointegration is strongly rejected by the data at the 5% level of significance for both λ_{max} and λ_{trace}. However, the null hypothesis of the, at most, one cointegrating vector cannot be rejected as both trace and maximum eigenvalue statistics are smaller than the critical values reported for each. Thus, it can be concluded that there exists a unique cointegrating vector for the model 2 for M1 at the 5% level of significance.

Table 2: Johansen Cointegration Tests for Models (1 &2), M1

Model	Hypothesized no of CE(S)	Test Statistics	5% Critical Values			
	H_0	Eigenvalue	λ_{max}	λ_{trace}	λ_{max}	λ_{trace}
Model 1	0		23.738*	40.94*	20.97	29.68
	At most 1	0.844	11.084	17.21*	14.07	15.41
	At most 2	0.634	6.119*	6.12*	3.76	3.76
Model 2	0		22.823*	36.135*	20.97	29.68
	At most 1	0.874	10.938	13.312	14.07	15.41
	At most 2	0.63	2.37	2.373	3.76	3.76

Note:*denotes the rejection of the null hypothesis at the 5% significance level. Critical values are from Source: Osterwald-Lenum(1992).

Table 3: Johansen Cointegration Tests for Models (1 &2), M2

Model	Hypothesized no of CE(S)	Test statistics	5% Critical Values			
	H_0	Eigenvalue	λ_{max}	λ_{trace}	λ_{max}	λ_{trace}
Model 1	0	-	34.932*	49.272*	20.97	29.68
	At most 1	0.958	10.72	14.339	14.07	15.41
	At most 2	0.623	3.62	3.618	3.76	3.76
Model 2	0	-	24.324*	39.013*	20.97	26.68
	At most 1	0.874	13.481	14.706	14.07	15.41
	At most 2	0.63	1.226	1.23	3.76	3.76

Table 3 shows the rank test for M2 for both hypothesized models 1 and 2. From the reported result, the null hypothesis of the zero cointegrating vectors is strongly rejected by the data in both models at the 5% significance level for both λ_{max} and λ_{trac} as both λ_{max} and λ_{trac} are greater than their corresponding 5% critical values. But, the null hypothesis of the, at most, one cointegrating vector is not rejected by both trace and maximum eigenvalue statistics because both trace and maximum eigen value statistics are smaller than the critical values reported for each. Therefore, we can conclude that there is a unique cointegrating vector for M2 at the 5% significance level.

Vector Error Correction Model (VECM) Results

As the variables in both models tested above are found to be cointegrated, a better way to explain the dynamic relationship between them is to use VECM. Thus, this study employed the VECM to tie the short-run behavior of each money demand to its long-run

equilibrium values. Under this method, the simultaneous effect of all the variables in the model on each other is estimated.

The short-run error correction model for money demand for Model 1 using M1 is given by the equation (4). Here, t-statictic and p-values are in round brackets and in squared brackets respectively. The coefficients of both (output and interest rate) have the expected sign, and are statistically significant. In the short-run, both variables output and interest rate have significant effect on the narrow money (M1). Although the error-correction term is significantly different than zero, it does not have the expected sign. This implies that the dynamic adjustment to an excess money supply by economic agents would be through increasing their demand for money, which would cause the dynamic stability in the demand for money.

$$\Delta lnRM1_t=0.006+0.742\Delta lnRM1_{t-1}+0.0433\Delta lnY_{t-1}-1.354\Delta R_{t-1}+0.1235EC_{t-1} \quad \text{.....(4)}$$

(0.0308) (0.0184) (0.29763) (0.492)
[2.401] [2.811] [-4.488] [0.251]

R^2=0.31 F-stastic=0.658 LM(2)=7.17 (0.73) LM(5)=5.31 (0.81)

Portmanteau test(1) Adj Q-stat=10.11 (0.34) Jarque-Bera Normality test=9.79 (0.99)

Residual Heteroskedasticity Test $\chi 2$=40.76 (0.098)

Equation (5) reports the short-run error correction model for money demand of Model 2 using M1, where t-statistic and p-values are in round brackets and in squared brackets respectively. The estimated results show that the coefficients of both GDP and interest rate have the sign that confirm to the money demand theory along with their statistical significance. Therefore, the short-run demand for M1 seems to be influenced by the lags of M1, GDP and interest rate. But, the error-correction term does not have expected sign.

$$\Delta lnRM1_t=0.0071+0.741\Delta lnRM1_{t-1}+0.0432\Delta lnY_{t-1}-0.249\Delta lnR_{t-1}+0.0022EC_{t-1} \quad \text{.....(5)}$$

(0.524) (0.0318) (0.0161) (0.595)
[2.393] [2.691] [-4.193] [0.0042]

R^2=0.33 F-stastic=0.983 LM(2)=4.685 (0.86) LM(5)=5.44 (0.79)

Portmanteau test(1) Adj Q-stat=6.867 (0.65) Jarque-Bera Normality test=9.695 (0.99)

Residual Heteroskedasticity Test $\chi 2$=39.5 (0.118)

Equation (6) is the error correction model of money demand for Model 1 using M2. The results obtained here are also very similar to those of M1. Here, both output and interest rate coefficients are statistically significant and have the expected sign. The coefficient of the GDP is positive i.e 0.04 and the coefficient of the interest rate is negative i.e. -1.335. This implies that the short-run demand for M2 is also influenced by lag of the both output and interest rate.

$$\Delta \ln RM2_t = 0.0082 + 0.885\Delta \ln RM2_{t-1} + 0.0434\Delta \ln Y_{t-1} - 1.335\Delta R_{t-1} + 0.537EC_{t-1} \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

(0.0258) (0.0081) (0.312) (0.2645)
[3.429] [5.321] [-4.293] [2.03]

R^2=0.35 F-stastic=2.049 LM(2)=7.96 LM(5)=8.62
(0.54) (0.473)
Portmanteau test(1) Adj Q-stat=5.69 Jarque-Bera Normality test=10.22
(0.72) (0.99)
Residual Heteroskedasticity Test $\chi 2$=40.46
(0.096)

$$\Delta \ln RM2_t = 0.0083 + 0.884\Delta \ln RM2_{t-1} + 0.0434\Delta \ln Y_{t-1} - 0.249\Delta \ln R_{t-1} + 0.556EC_{t-1} \quad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

(0.0259) (0.0082) (0.0629) (0.278)
[3.413] [5.289] [-3.966] [2.019]

R^2=0.361 F-stastic=2.036 LM(2)=5.67 LM(5)=10.24
(0.73) (0.33)
Portmanteau test(1) Adj Q-stat=6.22 Jarque-Bera Normality test=9.795
(0.72) (0.99)
Residual Heteroskedasticity Test $\chi 2$=36.28
(0.198)

From VECM, the estimated money demand function for M2 for Model 2 is given by equation (7). This equation also reports the same results as earlier. The coefficients of the output and interest are both statistically significant and have the expected sign. But the error correction term does not have the expected sign.

Dynamic OLS Results

As the existence of the cointegration relation was supported by the Johansen cointegration tests, the money demand function can be estimated by using the Dynamic OLS (Stock and Watson, 1993). The Stock-Watson approach is a robust single equation approach which corrects for regressor endogeneity by the inclusion of the leads and lags

of first differences of the regressors, and for serially correlated errors by GLS procedures.[6] In this study, the number of leads and lags is chosen arbitrarily to be 1.
Table 4 presents the estimation results obtained from DOLS with respect to Model 1 for M1. From this table, it is clearly observed that the coefficient of GDP is significantly estimated to be positive i.e 2.19 and the interest rate coefficient is estimated to be negative i.e -0.071.

Table 4: Dynamic OLS (M1, Model 1)

$$\ln M1_t - \ln P_t = \beta_0 + \beta_1 \ln y_t + \beta_2 R + \sum_{i=-k}^{k} \gamma_{yi} \Delta \ln y_t + \sum_{i=-k}^{k} \gamma_{ri} \Delta R_t + u_t$$

Variables	Coefficients	SE	t-stastic	P-value	R^2
Constant	-16.82	18.22	1.29	0.525	
					0.99
lnY	2.19	1.70	0.59	0.42	
lnR	-0.071	.12	-0.92	0.66	

Table 5: Dynamic OLS (M1, Model 2)

$$\ln M1_t - \ln P_t = \beta_0 + \beta_1 \ln y_t + \beta_2 \ln R + \sum_{i=-k}^{k} \gamma_{yi} \Delta \ln y_t + \sum_{i=-k}^{k} \gamma_{ri} \Delta \ln R_t + u_t$$

Variables	Coefficients	SE	t-stastic	P-value	R^2
Constant	-22.33	5.189	-4.3	0.145	
					0.98
lnY	2.68	0.479	5.61	0.112	
lnR	-0.035	0.144	2.46	0.246	

Table 5 shows the DOLS results of Model 2 for M1. This table also clearly shows that the output coefficient is 2.68 and the interest rate coefficient is -0.035. Thus, the sign condition of the money demand (M1) holds for both of the cases. In this way, it becomes apparent that not only the cointegrating relation was supported, but also the existence of the money demand function with respect to the M1 was statistically supported.
Next, we take the money demand function using M2 component. In the case of M2 also, as the existence of the cointegration was supported, the DOLS has been used to estimate the money demand function.

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[6] The DOLS estimators is based on the following augmented cointegrating regression, which includes the past, present and future values of the change in Xt,

$$Y_t = \beta_0 + \beta_1 X_t + \sum_{i=-k}^{k} \gamma_{ti} \Delta X_t + u_t$$

Where k represents the leads and lags of the variable, β_0 and β_1 are the parameters needs to be estimated. Y_t and X_t are the cointegrated variables.

Table 6: Dynamic OLS (M2, Model 1)

$$\ln M2_t - \ln P_t = \beta_0 + \beta_1 \ln y_t + \beta_2 R + \sum_{i=-k}^{k} \gamma_{yi} \Delta \ln y_t + \sum_{i=-k}^{k} \gamma_{ri} \Delta R_t + u_t$$

Variables	Coefficients	SE	t-stastic	P-value	R^2
Constant	-21.51	18.22	1.29	0.525	
					0.99
lnY	2.73	1.701	0.59	0.420	
lnR	-0.0031	0.121	-0.92	0.661	

Table 7: Dynamic OLS (M2, Model 2)

$$\ln M2_t - \ln P_t = \beta_0 + \beta_1 \ln y_t + \beta_2 \ln R + \sum_{i=-k}^{k} \gamma_{yi} \Delta \ln y_t + \sum_{i=-k}^{k} \gamma_{ri} \Delta \ln R_t + u_t$$

Variables	Coefficients	SE	t-stastic	P-value	R^2
Constant	-20.95	2.5	-8.38	0.076	
					0.99
lnY	2.675	0.231	11.57	0.055	
lnR	-0.0019	0.694	2.87	0.214	

Table 6 shows the estimation results of Model 1 for M2. It is evident from the table that the sign of the output coefficient is positive (2.73) and the sign of the interest rate coefficient is significantly negative (-0.0031). Table 7 shows the DOLS estimation outcome for the M2 with respect to Model 2. In this table also, the output coefficient was significantly estimated positive values of 2.675 and the interest rate coefficient was significantly estimated negative values of -0.0019. From this we can conclude that along with the existence of the cointegration relation, the existence of the money demand function with respect to M2 was statistically supported.

IV. CONCLUDING REMARKS

This paper empirically analyzed the money demand function for Nepal using annual data for the period of FY 1997/98 to FY 2009/10. The empirical results obtained from the cointegration analysis indicate that the real money balances M1 and M2 are cointegrated with the output as represented by GDP and interest rate, implying that a long-run relationship between the real monetary aggregates and independent variables (GDP and R) is established. The $VECM_S$ were employed to show the short-run dynamic relationship among monetary aggregates and scale variables. The cointegration and error correction results clearly show that there exist a long-run and short-run dynamic equilibrium between monetary aggregates (M1 & M2) and scale variables, GDP and interest rate. Furthermore, estimated results from Dynamic OLS also implied the statistical support for the existence of the money demand function with respect to both M1 and M2 under both

models. The declining value of velocity of money observed in this paper clearly reflects the growing monetization of the economy. As velocity of M2 was observed relatively stable than M1, it simply indicates the superiority of broad money over narrow money for policy purpose.

These derived empirical results from this paper imply that NRB can focus on both M1 and M2 control in order to achieve these goals. Future research on the money demand function may include different interest rates from money market in explaining money demand in short and long-run. In addition, the stability of the Nepal's money demand function, taking into account the currency substitution issue, may be the another issue for the researchers in order to suggest the ways for the effective formulation and implementation of the monetary policy of Nepal.

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Appendix 1: Data set used in the estimation of the Money Demand Function

Fiscal Year	GDP (Rs. In millions)	CPI	M1 Mid july (Rs. In millions)	M2 Mid july (Rs. In millions)	R Mid july
1975/76	1739.40	15.40	1452.50	2524.00	
1976/77	1728.00	15.80	1852.90	3223.00	
1977/78	1972.70	17.60	2060.60	3772.10	
1978/79	2612.80	18.20	2504.90	4511.40	
1979/80	2335.10	19.90	2830.40	5285.30	
1980/81	2553.00	22.60	3207.80	6307.70	
1981/82	3098.80	25.00	3611.50	7458.00	
1982/83	3382.10	28.50	4348.90	9222.40	
1983/84	3929.00	30.30	4931.50	10455.20	
1984/85	4658.70	31.50	5480.00	12296.60	
1985/86	5573.40	36.50	7029.30	15159.00	
1986/87	6386.40	41.40	8120.20	17498.20	
1987/88	7690.60	45.90	9596.60	21422.60	
1988/89	8927.00	49.70	11775.40	26605.10	
1989/90	10341.60	54.50	14223.00	31552.40	
1990/91	12037.00	59.80	16283.60	37712.50	
1991/92	14948.70	72.40	19457.70	45670.50	
1992/93	17149.20	78.80	23833.00	58322.50	
1993/94	19927.20	85.90	28510.40	69777.10	
1994/95	21917.50	92.50	32985.40	80984.70	
1995/96	24891.30	100.00	36498.00	92652.20	
1996/97	28051.30	108.10	38460.30	103720.60	
1997/98	30084.50	117.10	45163.80	126462.60	6.5-8.8
1998/99	34203.60	130.40	51062.50	152800.20	5.75-8.0
1999/00	37948.80	134.80	60979.70	186120.80	4.0-6.5
2000/01	44151.90	138.10	70577.00	214454.20	3.5-6.5
2001/02	45944.28	142.10	77156.20	223988.30	2.5-6.25
2002/03	49223.13	148.90	83754.10	245911.20	2.5-6.0
2003/04	53674.89	154.80	93973.70	277310.10	2.0-5.0
2004/05	58941.16	161.80	100205.80	300440.00	1.75-5.0
2005/06	65408.40	174.70	113060.80	346824.10	2.0-5.0
2006/07	72782.70	185.90	126888.00	395518.20	2.0-5.0
2007/08	81566.32	200.20	154343.90	495377.10	2.0-6.5
2008/09	99131.61	226.70	196459.40	630521.20	2.0-7.5
2009/10	118268.01	245.80	218519.00	719599.10	2.0-12.0

GDP: Gross Domestic Product, CPI: Urban Consumer Price Index, M1: Narrow Money, M2: Broad Money, R: Interest rate structure of the Commercial Banks at Savings Deposit.

Monetary Neutrality in the Nepalese Economy during 1975-2008

Mukesh Khanal*

Abstract

One of the methods of measuring the effectiveness of monetary policies is via inspection of monetary neutrality in the economy. It is a concept from classical economics and it suggests that changes in nominal variables do not have any impact on real variables. This paper studies the presence or absence of effective monetary policy in Nepal between 1975 and 2008 by observing money supply (nominal side), and real GDP (real). Results suggest that an increase in money supply immediately lowers the real GDP in the short run, but has no effect on real GDP in the long run. This evidence suggests that Nepal Rastra Bank's monetary policies between 1975 and 2008 may have been counter-productive in the short-run, but they were effective for long-run growth and stability of the Nepalese economy.

I. INTRODUCTION

Nations, through their central banks, apply monetary policies to achieve a desired level of growth and stability in the economy. Monetary policies control the flow of money supply, the availability of that money, and the rate of interest charged on borrowing or lending money. A monetary policy could, therefore, be either expansionary or contractionary. When an *expansionary* monetary policy is applied, money is infused into the economy, thus increasing the supply of money. On the other hand, a *contractionary* monetary policy results in the decrease of money supply in the economy.

The primary method of increasing or decreasing the money supply in any economy is by changing the interest rates. When the interest rate is lowered, it becomes cheaper to borrow money. Therefore, the supply of money in the economy increases. When the interest rate is raised, it becomes difficult for individuals and businesses to borrow money. Therefore, the supply of money in the economy decreases. The change in money supply via the application of different monetary policies aims to stabilize and grow an economy (Friedman, 2001).

The effectiveness of monetary policies in Nepal depend on factors like the authority's ability to control money supply, stable money demand, circulation of the Indian currency in the Nepalese market, and the development stage of financial markets (Acharya et. al.

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2003). But, these factors are very difficult to maintain control over. Despite legal prohibition, use of Indian currencies in the Nepalese market persists, even today, causing structural problems in the financial system. Also, the government authorities do not have absolute control over the balance of payments, and the government has lacked fiscal discipline at times. These factors, when combined, have resulted in a weaker monetary policy implementation in Nepal.

Like any other nation and its central bank, Nepal and Nepal Rastra Bank, have always had to work with monetary policies. However, extensive studies, on whether the monetary policies have been effective in Nepal, have been lacking. The objective of this paper is to study the effectiveness of monetary policies implemented by the Nepal Rastra Bank between 1975 and 2008. This effectiveness is examined by observing the classical economic concept of monetary neutrality held in Nepal during this period.

The rest of this paper is organized in the following manner: section 2 discusses the brief history of Nepalese monetary policies including pegging of Nepal currency to the Indian rupee; trends on the interest rate; the money supply section is also discusses the concept of monetary neutrality and why it needs to be looked into in the case of Nepal. Section 3 outlines the detailed research methodology employed in this research paper and presents a final economic model for the study. Section 4 shows the robustness check of the final model, and, finally, section 5 offers the conclusion of this research.

II. EXCHANGE RATE, INTEREST RATE AND MONEY SUPPLY IN NEPAL

Pegging the Nepali Rupee to Indian Rupee

When Nepal signed the Treaty of Peace and Friendship with India in 1950, the treaty resulted in a free flow of labor across the border between these two countries. In addition to this mobility of labor across the border, people were also free to convert Nepalese rupees into Indian rupees without any obstruction, and in an unlimited quantity. Until 1961, the Nepalese used both Indian rupees (IRs) and Nepalese rupees (NRs) within Nepal's border. The exchange rate would float and was determined by private money changers. While the ability to hold both types of currency was a definite plus point for the Nepali population, the frequent swings in the exchange rate due to availability or lack thereof of the Indian currency was causing problems (Acharya et. al. 2003).

When the Nepal Rastra Bank (NRB) was established in 1956, it promoted the use of the NRs within Nepal's borders. This essentially got rid of the dual currency system within Nepal's borders, and also helped the Nepalese government to stabilize the exchange rate between NRs and IRs according to its choice. To help the businesses and the general public, who were still doing businesses and making everyday purchases across the border, the NRB pegged the Nepalese rupee to the Indian rupee at 1.6:1, meaning NRs 1.6 was equal to IRe 1.

Although the Foreign Exchange Regulation Act of 1962 helped initiate the convertible exchange rates with currencies of other countries, the exchange rate between IRs and NRs stands the same today. There have been various attempts to get rid of the pegging system, but the high volume of every day cross-border purchases and trade between India and Nepal has posed a problem. Frequent adjustments between IRs and NRs are not possible given the massive amount of trade and purchases that occur daily. As a result, some modifications in terms of devaluation and revaluation between the IRs and NRs have been done in the past, but frequent exchange rate adjustments have seemed to be impossible to implement. Therefore, the IRs and NRs are still pegged today in the same ratio of 1:1.6.

The pegging of Indian and Nepalese currencies has proved to be very popular, and has contributed to the increasing cross-border trade between Indian and Nepal. However, this pegging system has resulted in some challenges, especially when it comes to monetary management and policies. The mere existence of Indian currencies inside Nepal has proved to be a hindrance while determining the demand of money in the Nepalese market. In addition, the easy substitution between these two currencies has resulted in a dampening effect when domestic money supply changes. Therefore, implementation of monetary policies in Nepal has had narrow coverage, and has not produced desired results (Acharya et. al. 2003). In other words, effectiveness of monetary policies in Nepal has been hampered due to the existence of ready supply of Indian currency in Nepalese market.

Interest Rates in Nepal

Nepal Rastra Bank's intervention in the credit market started in 1966 through interest rate changes. However, the intervention was not to influence monetary policies but to facilitate credit flow and mobilize other financial resources. Different financial instruments and different kinds of loans carried different interest rates. Determination of the interest rates were based solely on the NRB's discretion due to the absence of market based instruments (Maskay and Pandit, 2010). Since 1975, the NRB started using the interest rate manipulations to influence credit and money supply.

Interest rates in Nepal have been high since the early 1970s. The primary reason for adopting high interest rates was to ensure that no savings from Nepal would shift to India with hopes of a higher return. With this in mind, in 1975, the NRB increased the interest rates all across the board. As a result, savings and fixed deposits increased while credit market slowed down. The exchange rate was devalued in 1985 by 14.7 percent, and was revalued by 5 percent in the 1990s during a period when interest rate on bank deposits in Nepal were lower than that in India (Acharya et. al. 2003).

In 1984/85, the balance of payments problems that started plaguing Nepal resulted in accepting to adopt the International Monetary Fund's economic stabilization program (Thornton 1987). Being under IMF's structural adjustment facility meant that the NRB had to be flexible in its interest rates determination, and as a result, would have to allow other commercial banks with limited powers to influence the interest rates. Therefore, commercial banks in Nepal were given permission to set their interest rates on savings

1.5% higher, and on time deposits 1% higher than the NRB's interest rates (Maskay and Pandit, 2010). This flexibility was further enhanced in 1986 when the NRB announced that commercial banks could not charge an interest above 15%. Such deregulation was the IMF's way of ensuring increased competition among financial and banking sectors. This was believed to increase efficiency and mobilization of resources.

On August 31, 1989, the NRB abolished any form of controlled interest rate, essentially granting banks and finance companies to set whatever interest rates they wished appropriate on deposits and lending. The post-democracy, post-1990, era fostered competition and resulted in a rapid increase in the number of banks and finance companies. So, the economic post-1990 liberalization fostered the banking and financial sectors resulting in rapid growth of these sectors. However, time and again, the NRB has been forced to issue directives aimed at curtailing the high interest rate spread between lending and deposits (Maskay and Pandit 2010).

Money Supply in Nepal

Money supply in Nepal has always been affected by its balance of payments. Around 42 percent of the total money supply in Nepal during the 1980s was attributed to change in net foreign assets of the banking system (Acharya et. al. 2003). An improvement in the balance of payments during the 1990s meant that the foreign assets of the banking system had an increased contribution. However, net domestic assets of the banking system had declined during the same period, effectively neutralizing the expansionary contribution of foreign assets. After a brief decline in the balance of payment conditions during 1995/96, the situation improved after 1997. Till the end of 2008/09, there began a balance of payment surplus in Nepal.

There were attempts made to neutralize the impact of balance of payment surplus on the money supply in the country. In order to do this, the NRB issued the NRB bills between 1991 and 1994. However, the NRB resorted too much to the security instruments including the NRB bills, and as a result the interest rate on the NRB bills went up from 9.4 percent in 1992 to 11.1 percent in 1994. One of the reasons for this sterilization failure was the relatively inflexible exchange rate system in Nepal, mainly with regards to the Indian currency. If there were a rather flexible exchange rate system in Nepal, the effects would not have been so severe, and Nepal would not have experienced the high interest rates and excess monetary growth (Acharya et. al., 2003). However, if the NRB bills were not introduced, the money supply would have been even larger, even after accounting for inflation.

Table 1: Financial Development Indicators

Phase	Period	Average M2/GDP ratio	Average Currency/M2 ratio
Pre-interest rate	pre-1955	NA	NA
Controlled interes	1956-1983	17.5	48.4
Transition	1984-1989	27.5	31
Liberalized	1990-present	43.5	27.5

Source: NRB, CBS, GON, and calculations by Maskay and Pandit 2010

The growth in the financial sector, attributed to the financial deregulation by the NRB on the IMF's insistence, has been miraculous in Nepal. The growth can be examined by looking at the money supply in the economy (Table 1). The growth in the ratio of broad money (M2) to GDP shows that the money supply has grown significantly, and this in turn shows the development of financial sector in Nepal. The declining ratio of narrow money (currency) to broad money (M2) shows that use of currency has lowered significantly in Nepal, and this in turn, again, suggests the development of financial sector.

Monetary Neutrality in the Nepalese Economy

Monetary neutrality or the neutrality of money is a concept in classical economics. It suggests that change in money supply does not have any effect on real variables like GDP and employment; it only affects nominal variables like price, wage and exchange rate.

Therefore, the monetary neutrality concept suggests that if the changes in money stock and changes in real variables are independent, then money is neutral. This phenomenon, called the *classical dichotomy*, is a widely accepted notion in economics. Furthermore, it is widely accepted in economic theory that there is long-*term monetary neutrality* if the change in money stock does not have a long-term impact in the real variables such as real GDP (Lucas 1995).

Some researchers have shown that money supply, M2, has predictive content for subsequent movement in prices or income (Miyao, 2004). Because of this reason, money supply is often used as a guiding tool when it comes to making monetary decisions and policies. In some countries, like Japan, the money supply lost this predictive capacity during the 1990s, probably due to the failure of banks and the unreliable movement of bank loans.

There have been issues raised on whether money neutrality holds in the short-run or not. Economists have argued that even in cases where money neutrality holds in the long-run, it might not hold in the short-run. The one common example is the case of wages and prices remaining sticky in the short-run despite a change in money supply (Cripps, 1977). Therefore, many nominal variables remain unaffected in the short-run by a change in money supply, thus suggesting no monetary neutrality. However, economists do agree that monetary neutrality gives a good enough approximation of the behavior of any economy in the long run.

An effort to study the neutrality of money in Nepal, therefore, starts with the investigation of the long-term impact on the output level when there are changes in the money supply. From aforementioned discussions about the monetary policies of Nepal, it is difficult to ascertain if the Nepalese monetary policies have been sound and "tight". This research intends to observe whether the monetary policies of Nepal had any impact on its real output. That is, this research will investigate whether there was monetary neutrality present in the Nepalese economy.

III. DATA AND METHODOLOGY

Data

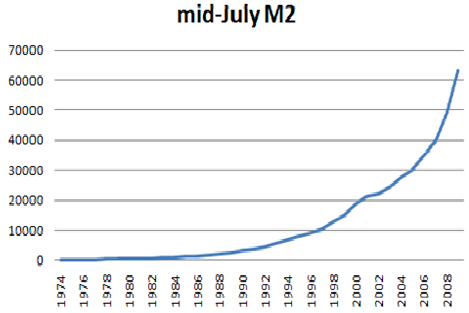

Figure 1: Money Supply

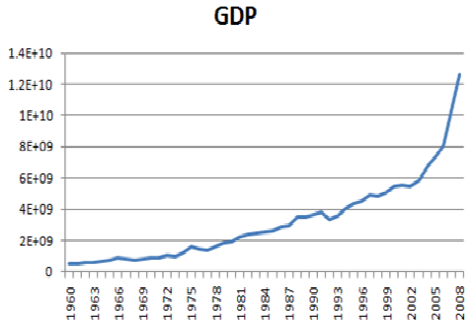

Figure 2: Real GDP

The time-trend graph of money supply, M2, shows that the money supply has kept increasing since early 1980s (Fig. 1). The time-trend graph of GDP shows that the GDP has moved in an increasing direction since 1960, albeit with a few hiccups every now and then (Fig. 2). The first significant drop can be noticed after 1975 when the GDP dropped due to the high oil prices resulting from the Second Oil Crisis. Like any other nation in the world dependent on oil for economic development, Nepal too suffered due to the crisis. Another significant drop in GDP occurred after 1991, right after the democracy of 1990. The revolution of the 1990 could have been the reasons for the drop. This reasoning seems to hold given how the economy bounces back in 1993, and the GDP starts growing again. Other than these two significant drops, the GDP of Nepal has maintained an increasing trend.

Methodology

Research since the late 1980's on the subject of monetary neutrality has focused on verification via vector autoregression modeling (Jacobson et. al., 1999). This study aims to test the theory of monetary neutrality in the Nepalese economy using tests on the order of integration of the money stock and real GDP, as well as with a vector autoregression model to determine the historical impact of a money supply shock on the level of real gross domestic product. Verification of monetary neutrality is a vital component in the

identification of business cycles, as it is often used as a restriction in structural equation models seeking to forecast macroeconomic fluctuations.

The long-run relationship between the money stock and real output is dependent on the order of integration of each variable. Order of integration of each variable is tested using unit root tests, specifically the standardized Augmented Dickey-Fuller test. Because of the low power of this test, Phillips-Perron test can be used as an alternative to test the autocorrelation and partial autocorrelation functions in order to investigate the stationarity of the time series in question (Elliott et. al., 1996). Robustness of the results against each of these measures helps to come to more definite conclusions about the order of integration.

The structural VAR estimation will be used to test for an endogenous relationship between the money supply and the real output. This gives a testable statistical measure of money neutrality hypothesis. After estimation of the model, monetary neutrality will be investigated in two ways:

Impulse response analysis will determine the effect of a shock to money on GDP and the effect of a shock to GDP on money. At this point, it can be seen how each variable evolves over time in response to shocks on the other, given constant exogenous factors (Mitchell, 2000).

Granger Causality Tests on the lagged factors of each variable will determine if one variable is a statistically significant "cause' of the other. This is accomplished via block F-tests on the coefficients of the accompanying lagged values of each variable.

Identification of Long Term Relationship

The first step is to determine whether shocks to money stock result in permanent changes to real output. For this purpose the long term rate of change of real output with respect to the money stock must be determined. Mathematically, this can be represented by:

$$\lim_{k \to \infty} \frac{\partial y_{t+k} / \partial u_t}{\partial m_{t+k} / \partial u_t}$$

That is, the long term derivative of real output with respect to the money stock must be determined. If the value of this expression is zero, then the effect of changes in money decays to zero as time moves forward, and monetary neutrality holds. If the money stock is stationary, no permanent shocks to the money stock exist, making this long term derivative divergent; monetary neutrality in this context is not testable.

Possible Relationship Cases[1]

The expression for monetary neutrality as the long-term derivative of real output with respect to the money supply yields five possible cases for the long-term relationship between money and real output.

Money supply is integrated of order zero (i.e. stationary): As stated above, if money is I(0) then long-term monetary neutrality cannot be tested, as shocks to the money supply are non-permanent by the property of the data series. This is due to the fact that the decay of the denominator of the long-term derivative results in divergence of the expression.

Money is integrated at order one or greater, but at a lower order than GDP: In this case long term monetary neutrality holds. Because GDP is integrated at a higher order, shocks to the money stock do not influence the growth rate of real output, yielding no permanent impact on GDP.

Money and GDP are integrated of the same order: This case requires determination of shocks to the money stock orthogonal to real output, requiring estimation of a structural model.

Money is integrated at order one or greater, but at a higher order than GDP: If money is integrated at an order higher than that of real output, then monetary neutrality holds, as changes to the money stock result in no permanent change to GDP. This is because the numerator of the long term derivative above converges to zero if the real output is stationary.

Money and GDP are co-integrated: Cointegration implies that there is some linear combination of money and GDP which is stationary. The relationship will converge to this linear combination, which may contain a constant and trend. Because of this "moving target," monetary neutrality cannot be tested with these methods in the event of cointegration.

Modeling Design and Procedure

While tests on the order of integration can determine the permanence of effects of monetary supply shocks on real output, demonstrating the evolutionary relationship between these variables requires the estimation of vector autoregression model. Modeling and testing for an endogenous relationship enables in finding short term effects, in addition to the tests for permanent effects yielded by the unit root tests. For this purpose, the following system of equations can be estimated:

$$Log(m_t)\Delta^x = a + \sum_{i=1}^{q} \alpha_i Log(y_{t-i})\Delta^z + \sum_{i=1}^{q} \beta_i Log(m_{t-i})\Delta^x \quad \text{.....equation 1}$$

$$Log(y_t)\Delta^z = a + \sum_{i=1}^{q} \lambda_i Log(y_{t-i})\Delta^z + \sum_{i=1}^{q} \gamma_i Log(m_{t-i})\Delta^x \quad \text{.....equation 2}$$

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[1] For a detailed review, see Walter Enders' *Applied Econometric Time Series 2nd edition.*

In these expressions, 'y' represents real output, 'm' represents money stock, 'delta' is the difference operator and 'x' and 'z' represent the order of integration of each variable.

Tests for the Order of Integration

Identification of the order of integration of each variable and comparison of these will determine which of the four cases the Nepalese economy falls under. Since co-integration is only possible in the event that the variables are integrated of the same order, this test is only required in the event that the variables do, in fact, have the same order of integration. However, this test will be performed regardless of the unit root test results to determine the robustness of the result.

Money Stock: The Augmented Dickey Fuller test does not have high power, and is sometimes sensitive to the number of lags in the estimation. Also, previous researches have shown that when the sample size is small, as in the case of this study where data ranges from 1975 to 2008, the ADF test is not very convincing (Hu et. al., 1992). Therefore, for convincing conclusions, the autocorrelation function and partial autocorrelation function will also be observed.

The ADF test on the log of M2 for a wide variety of lag specifications is presented in *Appendix A*. For each lag specification the test fails to reject the null hypothesis of a unit root. This suggests that the money stock is not stationary in level. A quick scan of the partial autocorrelation function (PACF) and autocorrelation function (ACF), shown in Figure 3, reveals slow decay in the autocorrelation pattern, an indication of non-stationarity.

Figure 3: ACF /PACF of LogM2

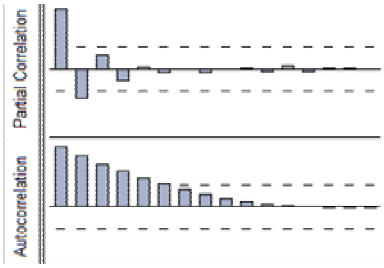
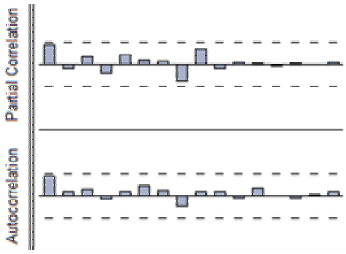


Figure 4: ACF/PACF of difference of LogM2



The ADF tests on the difference of the log of M2 for a variety of lag specifications to determine the stationarity is presented in *Appendix B*. The test rejects the null hypothesis of a unit root for shorter periods, but fails to reject the possibility of a unit root beyond the fourth lag. This suggests that difference of the log of the money stock i.e. growth of money supply, is stationary. Observing the ACF and PACF, shown in Figure 4, reveals a sharp decay in the autocorrelation pattern, thus suggesting stationarity. Also, prominent spike in the first lag, shown by the PACF, suggests that money supply is I(1).

Real GDP: The ADF test on the log of GDP for a wide variety of lag specifications is presented in *Appendix C*. For each lag specification the test fails to reject the null hypothesis of a unit root. This suggests that the GDP is not stationary in level form. Slow decay in the autocorrelation pattern, shown in Figure 5, is indication of non-stationarity.

Figure 5: ACF/PACF of Log GDP

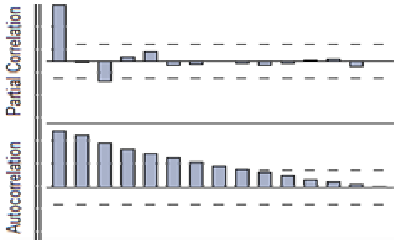
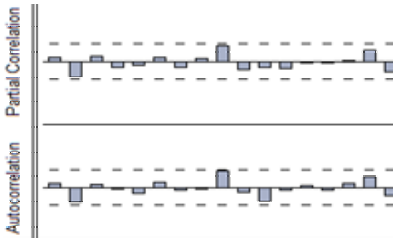


Figure 6: ACF/PACF of difference of Log GDP



The ADF tests on the difference of the log of GDP for a variety of lag specifications to determine the stationarity is presented in *Appendix D*. The test rejects the null hypothesis of a unit root for both shorter and longer periods. This suggests that difference of the log of the GDP, i.e. growth rate of GDP, is stationary. Observing the ACF and PACF, shown in Figure 6, reveals a sharp decay in the autocorrelation pattern, thus suggesting stationarity. The prominent spike in the first lag shown by the PACF suggests that GDP is I(1).

Test of Co-integration

The tests to determine the order of integration of money supply and GDP suggest that both these variables are integrated of order one i.e. I(1). This gives two possible cases: money and GDP are co-integrated, or money is integrated at an order higher than GDP. The second case supports money neutrality, whereas the first case asks for a structural model. A test for the endogenous relationship between GDP and money supply can confirm which of these two cases is applicable here.

The strong probability of both of these variables being integrated of order one means a test of co-integration is desirable. In order to test the co-integration, the number of lags that will be used has to be determined. The appropriate lag structure is suggested by a variety of information criterion, mainly the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC). The AIC tends to overestimate the order of lag selection, while the BIC tends to underestimate (Lutkepohl, 1991). So, both of these are used to come to a general consensus in order to avoid any bias in the selection of the lag structure. *Appendix E* shows the lag suggestions given by various criteria, and most of these criteria agree that a single lag should be used.

The test of co-integration between money supply and GDP is shown in *Appendix F*. It shows two types of tests for co-integration: the Johansen Trace test, and the Maximal

Eigenvalue test. The null hypothesis for the test of co-integration is that there is *no cointegration.* Both the tests fail to reject the null hypothesis, suggesting that there is no co-integrating relationship between money supply and GDP. While failure to reject *no cointegrating relationship* should not be interpreted as evidence in favor, the failure to detect *a co-integrating relationship* is evidence against its presence (Engel, 1987).

Vector Auto Regression (VAR) Estimate[2]

This study is a multivariate time series analysis, meaning there are at least two variables that are of time-series nature that are being analyzed in order to build an economic model. When it comes to describing and analyzing the dynamic nature of financial and economic time-series, and forecasting such series, the VAR model is superior to univariate forecasting models and simultaneous equation models. It is also useful when conducting a structural analysis to determine the impact on a particular variable in the model when there is an unexpected shock.

In this study, the VAR estimate will serve two purposes. First, the tests for stationarity indicated that both variables are I(1). So, this model estimation helps determine long-run monetary neutrality because the unit root tests are insufficient when variables are integrated of the same order. Second, this model will assist in quantifying the effect of a shock on the money supply to real output, giving an idea of the relative speed of the reaction and the rate of convergence.

The number of lags used in the VAR estimation is determined by the suggestion of various lag selection criteria shown in *Appendix E*. The selection criteria suggests that only one lag should be used. Although the selection criteria is unanimous in their suggestion to use only one lag, two lags will be used in the VAR estimation in order to avoid any bias resulting from omission.

The VAR estimation result, with two lags, is shown in *Appendix G*. The value of the t-statistics for the impact of money supply on GDP is low. The t-statistics for the impact of GDP on money supply is also low, but it is a little higher when compared to the first case. This evidence suggests that the impact of these two variables on one another is generally insignificant. For the sake of completeness, Appendix G also shows the VAR estimation result with only one lag. Once again, the t-statistics suggest that GDP has a slightly higher impact on money supply. However, their net impact on one another is insignificant.

IV. ROBUSTNESS OF THE MODEL

Structural Analysis of the VAR Estimate

Due to complex interactions between variables in a VAR estimation model, the dynamic properties of a VAR model is studied through structural analysis summaries, mainly the Granger Causality test and the Impulse Response Function.

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[2] For a detailed review, Walter Enders (2003).

Granger Causality test: If a variable is found to be helpful in predicting another variable, then the first variable is said to *Granger-cause* the second variable. It is important to note that this notion does not imply true causality, and only implies the forecasting ability of the first variable to forecast the second variable (Granger 1969).

Block F-tests, in the form of Granger Causality test, carried out on the coefficients of each series to observe the statistical causality is shown in *Appendix H*. For GDP's impact on money supply, the null hypothesis is that *GDP has no impact on money supply.* Similarly, for money supply's impact on GDP, the null hypothesis is that *money supply has no impact on GDP.*

The Granger Causality tests in this study fail to reject both the null hypotheses. Therefore, GDP does not *Granger-cause* money supply, and money supply does not *Granger-cause* GDP. In other words, GDP and money supply have no causal impact on one another. This holds true when either two or one lag is selected in the VAR estimate.

Impulse Response Function (IRF): The Impulse Response Function shows how a dynamic system responds when a sudden exogenous impulse or a 'shock' is applied to the system (Lutkepohl, 2008). The IRF in this study shows the response of the two endogenous variables at the time of the shock and over subsequent time periods. *Appendix I* shows the impulse responses of GDP and money supply to a Cholesky one standard deviation shock in either GDP or money supply.

The response of GDP to a one standard deviation positive shock to money supply shows that GDP responds negatively to growth in money supply. Immediately, the GDP decreases and this continues for the next couple of periods, and then GDP increases again to converge to its pre-shock level. This suggests that a shock in money supply does produce a significant reaction in the real sector as shown by the immediate decline of the GDP. Similarly, GDP responds negatively to a one standard deviation positive shock in GDP. The GDP declines for the next couple of periods, and then starts increasing again until it converges to its pre-shock level.

The response of money supply to a one standard deviation positive shock to money supply shows that money supply responds negatively to its growth. This suggests that if money supply increases this period, then it starts to decline in the next period, and so on, until it converges to the pre-shock level. However, money supply does not respond immediately to a one standard deviation positive shock in GDP. But, money supply increases for a couple of periods thereafter, until it falls again and converges again to its pre-shock level. The fact that money supply increases when there is a positive shock in GDP suggests that policymakers in Nepal, essentially the Nepal Rastra Bank, have not followed tight monetary policies.

V. CONCLUSION

The VAR estimation result shows the notion that money supply has a permanent effect on real GDP is rejected. The evidence suggests that changes in money supply do not have a permanent effect on real GDP. However, the Cholesky one standard deviation positive shock suggests that in the short-run an increase in money supply immediately lowers the GDP, thus showing a negative response. This responsiveness of the real GDP to a change in money supply suggests that in the short-run, real variables in the Nepalese economy do get affected by changes in monetary policies.

However, the Cholesky shock test suggests that the effects are in the short run only. Both the Cholesky shock test and Granger causality test confirm that in the long-run, monetary policies do not affect the real variables. Therefore, in the long-term, the concept of monetary neutrality has held true in the Nepalese economy between 1975 and 2008. This, in turn, suggests that monetary policies practiced by the Nepal Rastra Bank may have been counter-productive in the short run, but have been effective for the long run growth and stability of the economy.

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APPENDIX A: The ADF test on the Log of Money Supply

Null Hypothesis: LM has a unit root
Exogenous: Constant
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.393906	0.5737
Test critical values:	1% level	-3.639407	
	5% level	-2.951125	
	10% level	-2.614300	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LM has a unit root
Exogenous: Constant
Lag Length: 2 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.997554	0.7426
Test critical values:	1% level	-3.646342	
	5% level	-2.954021	
	10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LM has a unit root
Exogenous: Constant
Lag Length: 3 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.482263	0.8821
Test critical values:	1% level	-3.653730	
	5% level	-2.957110	
	10% level	-2.617434	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LM has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.179185	0.6706
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

*MacKinnon (1996) one-sided p-values.

APPENDIX B: The ADF test on the Difference of the Log of Money Supply

Null Hypothesis: D(LM) has a unit root
Exogenous: Constant
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.067745	0.0390
Test critical values:	1% level	-3.646342	
	5% level	-2.954021	
	10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LM) has a unit root
Exogenous: Constant
Lag Length: 2 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.465437	0.1331
Test critical values:	1% level	-3.653730	
	5% level	-2.957110	
	10% level	-2.617434	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LM) has a unit root
Exogenous: Constant
Lag Length: 3 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.646691	0.0948
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LM) has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.915913	0.3209
Test critical values:	1% level	-3.670170	
	5% level	-2.963972	
	10% level	-2.621007	

*MacKinnon (1996) one-sided p-values.

APPENDIX C: The ADF test on the Log of GDP

Null Hypothesis: LGDP has a unit root
Exogenous: Constant
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.263878	0.9738
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LGDP has a unit root
Exogenous: Constant
Lag Length: 2 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.336260	0.9778
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LGDP has a unit root
Exogenous: Constant
Lag Length: 3 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.273122	0.9743
Test critical values:	1% level	-3.584743	
	5% level	-2.928142	
	10% level	-2.602225	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LGDP has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.327316	0.9772
Test critical values:	1% level	-3.588509	
	5% level	-2.929734	
	10% level	-2.603064	

*MacKinnon (1996) one-sided p-values.

APPENDIX D: The ADF test on Difference of Log of GDP

Null Hypothesis: D(LGDP) has a unit root
Exogenous: Constant
Lag Length: 1 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.560754	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LGDP) has a unit root
Exogenous: Constant
Lag Length: 2 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.552777	0.0109
Test critical values:	1% level	-3.584743	
	5% level	-2.928142	
	10% level	-2.602225	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LGDP) has a unit root
Exogenous: Constant
Lag Length: 3 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.128085	0.0317
Test critical values:	1% level	-3.588509	
	5% level	-2.929734	
	10% level	-2.603064	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LGDP) has a unit root
Exogenous: Constant
Lag Length: 4 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.971989	0.0456
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

APPENDIX E: Determination of the lag length for the VAR

Sample: 1960 2010
Included observations: 29

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-32.27859	NA	0.036456	2.364041	2.458337	2.393573
1	88.52158	216.6072*	1.16e-05*	-5.691143*	-5.408254*	-5.602546*
2	91.11487	4.292341	1.28e-05	-5.594129	-5.122647	-5.446467
3	92.39245	1.938404	1.57e-05	-5.406376	-4.746302	-5.199649
4	96.12467	5.147884	1.63e-05	-5.387908	-4.539242	-5.122116
5	97.95397	2.270860	1.97e-05	-5.238205	-4.200946	-4.913348
6	101.6370	4.064012	2.13e-05	-5.216344	-3.990492	-4.832422

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

APPENDIX F: Test of Co-integration between Log of Money Supply and Log of GDP

Sample (adjusted): 1976 2008
Included observations: 33 after adjustments
Trend assumption: Linear deterministic trend
Series: LM LGDP
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.268315	11.32355	15.49471	0.1924
At most 1	0.030266	1.014199	3.841466	0.3139

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.268315	10.30935	14.26460	0.1924
At most 1	0.030266	1.014199	3.841466	0.3139

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

APPENDIX G: The VAR Estimate

Sample (adjusted): 1976 2008
Included observations: 33 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DLM	DLGDP
DLM(-1)	0.320972	-0.010321
	(0.17689)	(0.31976)
	[1.81448]	[-0.03228]
DLGDP(-1)	0.038464	0.049319
	(0.10106)	(0.18268)
	[0.38060]	[0.26997]
C	0.111716	0.061506
	(0.03216)	(0.05814)
	[3.47348]	[1.05794]
R-squared	0.099738	0.002898
Adj. R-squared	0.039721	-0.063576
Sum sq. resids	0.060538	0.197808
S.E. equation	0.044921	0.081201
F-statistic	1.661822	0.043595
Log likelihood	57.14146	37.60493
Akaike AIC	-3.281300	-2.097268
Schwarz SC	-3.145254	-1.961222
Mean dependent	0.166075	0.063034
S.D. dependent	0.045841	0.078737

Determinant resid covariance (dof adj.)	1.31E-05
Determinant resid covariance	1.09E-05
Log likelihood	94.95009
Akaike information criterion	-5.390915
Schwarz criterion	-5.118822

Sample (adjusted): 1977 2008
Included observations: 32 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DLM	DLGDP
DLM(-1)	0.413026	-0.172200
	(0.19534)	(0.32906)
	[2.11440]	[-0.52331]
DLM(-2)	-0.022857	-0.177370
	(0.18794)	(0.31660)
	[-0.12162]	[-0.56023]
DLGDP(-1)	-0.003171	0.183009
	(0.10945)	(0.18437)
	[-0.02898]	[0.99262]
DLGDP(-2)	0.096694	-0.250126
	(0.11058)	(0.18627)
	[0.87444]	[-1.34279]
C	0.095347	0.128661
	(0.04075)	(0.06865)
	[2.33963]	[1.87416]
R-squared	0.169335	0.120783
Adj. R-squared	0.046273	-0.009471
Sum sq. resids	0.054813	0.155541
S.E. equation	0.045057	0.075900
F-statistic	1.376015	0.927285
Log likelihood	56.50710	39.81927
Akaike AIC	-3.219194	-2.176204
Schwarz SC	-2.990173	-1.947183
Mean dependent	0.164984	0.067544
S.D. dependent	0.046137	0.075543

APPENDIX H: Granger Causality Test

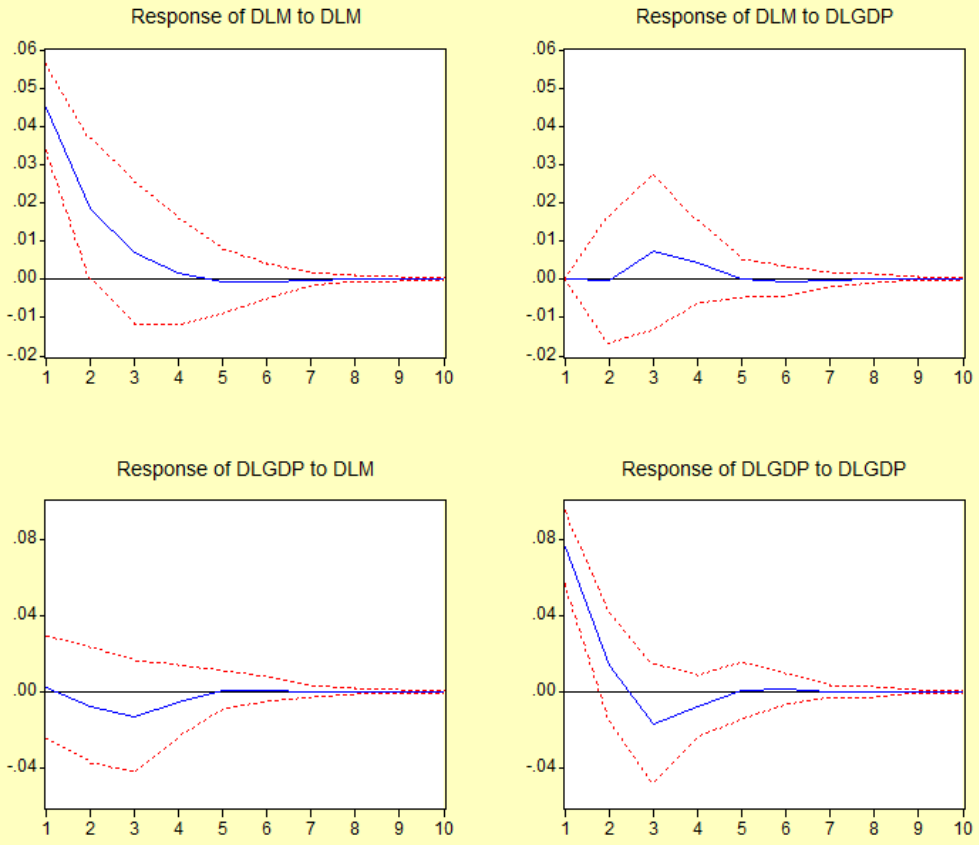
Sample: 1960 2010
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
DLGDP does not Granger Cause DLM	33	0.14486	0.70618
DLM does not Granger Cause DLGDP		0.00104	0.97447

Sample: 1960 2010
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
DLGDP does not Granger Cause DLM	32	0.38850	0.68180
DLM does not Granger Cause DLGDP		0.43811	0.64976

APPENDIX I: Impulse Response Function



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