Exchange rate policy in a dollarized economy: Implications on growth and employment in Bolivia

RESEARCH PROPOSAL – FINAL VERSION

Presented to

Partnership for Economic Policy (PEP)

By

Carlos Gustavo Machicado S.

&

Beatriz Muriel, Alejandra Goytia, Mario Arduz

Bolivia

July 11, 2018
There are three main areas/dimensions to all PEP-supported projects: capacity building, research and policy engagement. Each dimension must be considered with due care and attention, as they will be assessed individually and concurrently to determine the overall quality of a proposal.

The PEP proposal template is structured in five sections, as follows:

- Project overview and objectives
- Capacity building – team composition and experience
- Research – literature review, method and data
- Policy relevance and engagement strategy
- Other considerations

SECTION I – PROJECT OVERVIEW & OBJECTIVES

1.1. Abstract (max 100 to 250 words)

The abstract should state the main research question, the context and its relevance in terms of policy issues/needs in relation to PAGE priority issues. Complete with a brief description of the method and data that will be used.

In the last ten years, Bolivia has experienced unprecedented economic conditions. Annual economic growth has been on average 5%. Poverty levels have been reduced in around 20 percentage points. The Non-Financial Public Sector has experienced eight years of fiscal surplus (2006-2013) as well as the current account (2006-2014). But these favourable conditions seem to be reached an inflection point since 2014, and important economic policy decisions have to be...
taken in order to prevent an economic collapse in the form of a Balance-of-Payment and currency crisis.

One of these decisions and perhaps the most important is whether to maintain the fixed exchange rate policy that has been adopted since November 2011. But this is a tough decision as it involves putting in risk the process of bolivianization (the opposite of dollarization), the control of the inflation and the equilibrium of the financial system. Therefore this research proposal aims to analyze how a devaluation policy could impact the economic growth, the composition of the economic sectors, employment and poverty. The analysis will be based on a CGE model, based on an updated Social Accounting Matrix (SAM) that includes the financial system and with the novelty that the devaluation will be endogenous to the model in the sense that the actual economic conditions like the deficit of the current account, the fiscal deficit, the declining international reserves and a self-fulfilling demand for dollars, will push the exchange rate to devaluate. Thus, the model will also answer the question: How long could the fixed exchange rate policy be maintained before it collapses by itself? As usual in this type of models, different scenarios will be simulated before and after the devaluation.

1.2. Main research questions and contributions (max 500 to 700 words)

Explain the focus (or key questions) of your research and its policy relevance. Explain why you think this is an interesting research question and what the potential usefulness and value added of your work might be - in terms of both (general) knowledge gaps and policy needs for evidence base.

The literature review shall be detailed under "Research" (section III), not in this section.

Bolivia's modern economic history starts in 1952 (Kehoe, et. al., 2015). During these 65 years, two periods have been identified as the fastest growing: 1958-1978 and 2006-2014. In both periods, real GDP grew by around 5%, and GDP per capita grew by 2.5% in the first period and by 3.2% in the second period. In this last period, economic growth allowed reducing poverty levels, driven by labor earnings that grew significantly following the expansive cycle (Muriel and Vera, 2015). In 2006, the moderate poverty level was 59.9% and extreme poverty was 37.7%, this meant that 4 out of 10 Bolivians were considered extreme poor. In 2014, moderate poverty fell to 39.1% and extreme poverty to 17.2%, but these rates did not improve during 2015-2017.

Two main features are common in these two boom periods. The first is the high increase in world prices of Bolivian export commodities. The second is that the government adopted a fixed nominal exchange rate policy, which resulted in an appreciation of the real exchange rate (RER). In the first period, after the positive shock of international commodity prices, Bolivia had to confront a severe economic crisis. In the current period, the recent fall in international commodity prices is causing a slowdown in the economy and it seems that Bolivia is heading to a Balance-of-Payment and currency crisis. This perspective is also fed by the low probability of maintaining the same volumes of main export commodity (i.e. natural gas).

The research will focus in the actual period. We will calibrate the Bolivian economy to address the issues of a fixed nominal exchange rate regime, a growing economy with important changes in its sector composition, a dollarized economy, and poverty reduction. We will include specific characteristics of the Bolivian labor market for better evaluating labor outcomes. A first fundamental consideration is that we will take into account fundamental imperfections in the Bolivian labor market, which, in particular, led to poverty reduction through informal employment dynamics. In particular, informal workers (unskilled) have benefited from the boom period, given the higher demand of non-tradable sectors, but the corresponding labor earnings have been falling during the last years.
On the other hand, the adoption of a fixed exchange rate policy has had the following advantages in the nominal side:

1. It has been possible to de-dollarize the economy. In 2003 the dollarization of deposits was 90% and they fell to 18% in 2014.
2. It has been possible to anchor the inflation to the exchange rate. In 2011 inflation was 9.81% and from 2011 onwards, once the exchange rate was fixed, it has been on average 4.75%.

However, the advantages on the real side are not clearly identified. Some hypotheses are:

1. Main export sectors, like mining and hydrocarbons use more imported inputs than other sectors (Muriel and Herrera, 2018). These sectors benefited from the appreciated real exchange rate, because their costs have reduced as well as from the positive price shocks. However, other tradable sectors -usually more labor intensive- have been adversely affected, as they have lost competitiveness.
2. Bolivianization allowed for an additional source of government funding which is the seigniorage. This funding has been used to finance some expenditures and investments of public enterprises.
3. There has been employment reallocation between sectors, favoring both the main export and non-tradable sectors, but hurting other sectors like manufacturing. For instance, textile product exports as a share of GDP have fallen from 0.47% in 2012 to 0.14% in 2017.
4. The reduction of poverty (and the fall in inequality) was driven by the increase of labor earnings mainly from informal activities, usually associated to unskilled workers.

The calibration will focus on these advantages and disadvantages and with a CGE model we will test, for instance, the possible changes on the real sector by modifying the fixed exchange rate policy towards a flexible exchange rate policy. Therefore, the main question we aim to answer with this research is: What would be the impact of abandoning the fixed exchange rate policy on growth, employment and poverty, in a period of depressed international commodity prices? But, we don’t want to answer this question by simulating an exogenous devaluation or depreciation of the nominal exchange rate, as it is usual in most CGE models. We want to endogeneize the process of devaluation taking into account that the Bolivian economy, as a bi-monetary economy, has an endogenous mechanism operating first through the fiscal deficit and second through the people’s demand of dollars that could put pressure and accelerate the devaluation of the nominal exchange rate.

Answering this question is very important for the Bolivian economy for the following reasons:

1. To maintain a fixed exchange rate, it is crucial to have a current account surplus. Since 2014, there is a current account deficit and so international reserves have been falling during the last years.
2. In a bi-monetary economy, easing the exchange rate can lead to an increase in the demand for dollars, generating a process of depreciation that could increase inflation.
3. It is also mandatory to have a controlled fiscal deficit to maintain a fixed exchange rate. Fiscal deficit has been increasing in the last years, exacerbating the debt growth rate.
4. In terms of economic policy, there is the doubt as to whether the government should wait until there is no other option than to devalue or should move forward by applying a policy of gradual devaluation.

These questions are crucial in a context where the fall in international prices are slowing down the economic growth, increasing unemployment, and, as showed by Muriel and Vera (2015), reversing the poverty reduction through lower labor earnings.

In addition, an endogenous process of devaluation has not been analyzed before with a CGE model for a partially dollarized economy. So we believe that this research could be an important contribution for CGE modeling and to understand economic policy mechanisms in partially bi-
SECTION II – CAPACITY BUILDING

2.1. Team composition and experience

For each research team member, please indicate (using the following tables – one per member):

1. **Age, sex, as well as relevant/prior training and experience** in the issues and research techniques involved (start with team/project leader).
   - Note that PEP favors gender-mixed teams, composed of a maximum of four (4) members, at least 50% female researchers, and at least two (2) junior researchers (aged under 30), all contributing substantively to the research project. PEP also seeks gender balance in team leaders and thus positively encourages female-led research teams.
   - Each listed member must post an up-to-date CV in their profile on the PEP website – refer to “How to submit a proposal” on the call’s webpage.

2. **Benchmark and expected capacity building:**
   - Describe the research capacities that each team member (and potentially her/his affiliated institutions) is expected to build through their participation in this project. This is an important aspect in the evaluation of proposals and should be presented in detail.
     - What techniques, literature, theories, tools, etc. will each team member and her/his institutions learn (acquire in practice) or deepen her/his knowledge of?
     - How will these skills help each team member in their career development?
     - What are the current state of knowledge of each team member in regard to the project you are proposing?

3. **Task and contributions to project:** Indicate the specific tasks each team member would carry out in executing the project.
   - Note that one of the team members must be clearly identified as responsible for coordinating and reporting on the design/implementation of the projects’ policy engagement and communication strategy (see section III below). To achieve a more balanced task distribution, PEP advises to select a member other than the project leader.

### Team leader

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Sex (M, F)</th>
<th>Highest degree/ diploma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carlos Gustavo Machicado S.</td>
<td>44</td>
<td>M</td>
<td>Ph.D.</td>
</tr>
<tr>
<td><strong>Training and experience</strong></td>
<td></td>
<td></td>
<td>More than 10 years working as senior researcher at INESAD Foundation. He has ample experience on macroeconomics. In most of his research he has used general equilibrium</td>
</tr>
<tr>
<td>Expected capacity building</td>
<td>models (CGE and DSGE). He has been also instructor for the Bolivian Central Bank in General Equilibrium models. He aims to update his skills on CGE modelling, learn the latest techniques and build a new and updated SAM for the Bolivian economy.</td>
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<tr>
<td>Contribution to project</td>
<td>Lead the project and organize the work. Develop the set of equations to be included in the model to endogeneize the process of exchange rate devaluation for a partially dollarized economy. Set up the equations for the model and SAM update + GAMS.</td>
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</table>

Team member #2

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Sex (M, F)</th>
<th>Highest degree/diploma</th>
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</thead>
<tbody>
<tr>
<td>Beatriz Muriel Hernández</td>
<td>47</td>
<td>F</td>
<td>Ph.D.</td>
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</tbody>
</table>

Training and experience

Beatriz Muriel H. holds Ph.D. and Master degrees in Economics from the Catholic University of Rio de Janeiro. She has worked in both Bolivia and Brazil governments and academia, which allowed her to apply her thorough theoretical and empirical background to economic development problems. She has more than ten years of experience on labour economics research. For this topic, she has produced more than 15 Working Papers, five specialized articles and participated in six books. Under her coordination, she has developed more than 250 indicators on labour issues using household and firm surveys as well as national accounts from 1988 to 2014. This information is available for everyone at www.eminpro-inesad.com.

Expected capacity building

She aims to update his skills on CGE modelling, in particular including a better modeling of Bolivian labor characteristics (e.g., high levels of informality).

Contribution to project

Set up the micro-macro links needed to evaluate labor market outcomes, and establish de MSM analysis.

Team member #3

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Sex (M, F)</th>
<th>Highest degree/diploma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alejandra Goytia</td>
<td>23</td>
<td>F</td>
<td>B.Sc.</td>
</tr>
</tbody>
</table>

Training and experience

No experience in CGE modelling.

Expected capacity building

Learn how to build the SAM, calibrate the model and run it in GAMS.

Contribution to project

Collect data, calibrate the model, estimate parameters, set up the equations, run the model in GAMS, help on MSM part.

Team member #4
Name | Age | Sex (M, F) | Highest degree/thisoma
--- | --- | --- | ---
Mario Arduz | 22 | M | B.Sc.

**Training and experience**
No experience in CGE modelling

**Expected capacity building**
Learn how to build the SAM, calibrate the model and run it in GAMS.

**Contribution to project**
Collect data, calibrate the model, estimate parameters, set up the equations, run the model in GAMS, help on MSM part.

### 2.2. List of past, current or pending (non-PEP) projects in related areas involving team members, including resulting publications (If any)

Name funding institution, title of project and related publications, list of team members involved.

<table>
<thead>
<tr>
<th>Name of funding institutions</th>
<th>Title of projects and related publications (link)</th>
<th>Team member(s) involved</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Beatriz Muriel and Carlos Gustavo Machicado</td>
</tr>
<tr>
<td>International Development Research Centre (IDRC) and Centro de Estudios Distributivos Laborales y Sociales (CEDLAS)</td>
<td>Title: Employment and Labor Regulation: Evidence from Manufacturing Firms in Bolivia, 1988-2007</td>
<td>Beatriz Muriel and Carlos Gustavo Machicado</td>
</tr>
<tr>
<td>No funding</td>
<td>Title: Liquidity shocks and the dollarization of a banking system</td>
<td>Carlos Gustavo Machicado</td>
</tr>
<tr>
<td>International Development Research Centre (IDRC) and Danish Cooperation</td>
<td>Title: Building an Effective Tool based on information for Policy Discussion and Influence: THE EMINPRO NETWORK (see: <a href="http://www.eminpro-inesad.edu.bo">www.eminpro-inesad.edu.bo</a>).</td>
<td>Beatriz Muriel and others</td>
</tr>
</tbody>
</table>

Milenio Fundation and Danish Cooperation
Title: Labor Regulation and Labor Market: Main Challenges for Bolivia
Publication (reference): Book: Labor Regulation and Labor Market: Main Challenges for Bolivia
Beatriz Muriel and Rubén Ferrufino

International Development Research Centre (IDRC)
Title: Employment and Income in Peru, Bolivia and Paraguay: Analysis of the links between labor demand and supply in urban and rural area
Beatriz Muriel and others

Educate Girls Globally and International Development Bank
Title: Rural Girls’ Primary Education and Urban Female employment in Bolivia
Beatriz Muriel and others

2.3. List of past or current PEP-supported projects involving team members, including resulting publications

<table>
<thead>
<tr>
<th>Project code (e.g. PMMA-12345)</th>
<th>Title of project and related external (non-PEP) publications, if any</th>
<th>Team member(s) involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPIA 11343</td>
<td>Title: Public Expenditure Policy in Bolivia, Growth and Welfare</td>
<td>Carlos Gustavo Machicado</td>
</tr>
</tbody>
</table>

SECTION III – RESEARCH

3.1. Literature review (max 1000 to 1500 words)

Explain specific gaps in existing literature that your research aims to fill. You might want to explain whether or not this question has been addressed before in this context (including key references), and if so, what you wish to achieve (in addition) by examining the question again?
CGE models have been used extensively in Bolivia to address different topics; starting with Luis Carlos Jemio, who developed his Ph.D. thesis on this issue. Jemio (2001) and Jemio and Wiebelt (2002) are the firsts papers in this regard. The approach used in both papers is based on a recursive-dynamic CGE model, which takes into account the real and financial sides of the economy. They use data from 1997 organized in a SAM, and the model includes assets and liabilities in American dollars to take into account the dollarization process in Bolivia. In both cases, the impacts of external shocks on the economy are analyzed.

Based on this model, with some variations and updated data, external shocks and different macroeconomic issues have been analyzed by several authors, who linked the impacts on both labor and poverty issues. Among of them are: Andersen and Faris (2002); Thiele and Wiebelt (2003); Andersen and Evia (2003); Lay et al. (2004); Andersen et al. (2006); Wiebelt (2004); Nunnenkamp et al. (2007); Klasen (2006); Aliaga et al. (2007); Aliaga et al. (2009); Aliaga and Aguilár (2009); Lay et al. (2008); Aliaga et al. (2009); Aliaga and Aguilar (2009); Villegas et al. (2010); Aliaga and Villegas (2011).

Among these papers, we highlight Villegas et al. (2010) and Aliaga and Villegas (2011) because they combine micro-simulations with a real-financial CGE model. In both cases, the CGE model is linked with the 2007 Bolivian Household Survey in a sequential way, where each labor earning (for each labor category) is scaled up or down according to the CGE model. The first paper analyzes public investment on moderate poverty, while the second in addition focuses on extreme poverty.

Tellería et al. (2007) and Tellería and Ludeña (2015) employ the GTAP model (real side and recursive CGE model) including micro-simulations to analyze the wellbeing changes at the household level as a results of trade agreements with the United States and the European Union, respectively. They calculate the upper bound of household’s expenditure change caused by price changes predicted by the CGE model. Free trade is also analyzed by Jimenez (2007) by employing the MAMS model.

Zavaleta (2010) also developed a CGE model for Bolivia to analyze the effects of an increase of natural resources on poverty and inequality. The model is static and considers only the real side of the economy, but contributes to literature by using the exact aggregated representative household (EARH) approach to link micro with macro equations. Barja et al. (2014) also used this model to simulate commodity shocks to analyze Dutch disease effects.

Canavire and Mariscal (2010) employ another real side recursive CGE model called MACEPES (Modelo de Análisis de Choques Exógenos y de Protección Económica y Social) developed by Cicowiez and Sánchez (2009), which includes also a microsimulation under a top-down approach. They simulate external shocks and policies (e.g. fall of export commodities prices, capital outflows and tariffs reductions) on poverty and inequality.

Lastly, Cicowiez and Machicado (2011) and Morales et al. (2016) used the PEP 1.1 model. The first authors analyzed the impact of the global financial crisis of 2008 on the Bolivian economy, while the second authors focused on the impact of wage policy on informality and growth.

The closest CGE model to our proposal is the one of Jemio (2001), Jemio and Wiebelt (2002) and Schweickert et al. (2005) (including micro-macro simulations links), who as mentioned before, employ a real-financial CGE model for Bolivia. But we want to go further by incorporating an endogenous devaluation mechanism in the line of the Balance-of-Payment and currency crisis literature to generate a novel CGE model. The foundation of Balance-of-Payment and currency crises literature begins with Krugman (1979) and Flood and Garber (1984), where persistent fiscal deficits or raising debt levels with a constant decrease of reserves (unsustainable fiscal policy) are related with a foreseeable depreciation of a currency. This logic leads to a concomitant

\[1\] However, De Franco and Godoy (1992) and Gibson and Godoy (1993) use basic real CGE models to analyze coca production and its interaction with the economy.
speculative attack of investors where they seek to acquire government’s reserves of foreign money before they become depleted. This is the mechanism of devaluation under the first-generation models of Balance-of-Payment crisis. There are also second and third generation models that include self-fulfilling prophecies besides the speculative attacks and banking crises respectively (see Jeanne, 2000; Burnside, et al., 2016; Razin and Goldstein, 2012; and Agenor and Montiel, 2015).

Finally, notice that the literature on CGE models has not considered endogenous exchange rates variation. A few examples include: Yeldan (1998) who uses a real CGE model under Structuralist/Keynesian macro foundations, to allow for an endogenous determination of the exchange rate. Dixon (2014) develops a real-financial CGE model where this endogeneity is derived from the assumption that the capital account is equal to the current account. Acharya (2014) uses a real CGE model taking into account flexible exchange rates with exogenous foreign savings.

3.2. Methodology (max 1200 to 1600 words)

Presentation of the specific techniques that will be used to answer the research questions and how exactly they will be used to do so.

- Explain whether you will use a particular technique normally used in other contexts or whether you intend to extend a particular method and how you will do so.

- Explain if these methods have already been used in the context you are interested in (including key references).

- For PMMA (microeconomic analysis) proposals only: In case the proposed methodology aims to empirically estimate a causal relationship, explain potential sources of endogeneity in the context of your research, and how the proposed technique(s) would allow the identification of the relevant parameters.

The approach will follow two phases. The first phase will consist on modeling the financial side into a real model that could be the Exter or the PEP 1.1 model (including micro-macro links). If possible we will incorporate an endogenous devaluation mechanism that works through the link between the real and financial side of the economy. The second phase will consist on applying the model to the Bolivian data.

**First phase**

As we saw in the literature review, there are several papers that employed real-financial CGE models for Bolivia, based on Jemio (2001) and Jemio and Wiebelt (2002), including also micro-macro links. In addition, if one performs a Google search with the words: Devaluation and CGE, one of the papers that first appear is the paper from Schweickert et.al. (2005) which is precisely a real-financial CGE model, based on Wiebelt (2004).

This real-financial CGE model that we plan to adapt to the Exter or PEP 1.1 model will evaluate two lines of research regarding real-financial CGE models. One approach that is in line with Bourguignon (1989), Rosenzweig and Taylor (1990), Telli et al. (2003), Lewis (1991) and Agenor et al. (2006), among others, consider the savings, investment and portfolio behavior for each agent (including commercial banks and the central bank) in the accounting identity embodied in the capital account of the Social Accounting Matrix (SAM). In general, they assume that: total assets = total liabilities + net wealth. The composition of assets and liabilities varies between agents, and for the Bolivian economy it should also consider foreign assets/liabilities, because the Bolivian economy is a dollarized or bi-monetary economy.
A somewhat different approach is used by Naastepad (2001, 2003), Simorangkir and Adamanti (2012), Dixon (2014), Liu (2015) and Giesecke (2017), where the model is composed by two blocks: The traditional real side and the financial side. The financial side considers the interactions between financial agents, which are carried out under a structure of asset/liabilities markets, as a result of agents’ optimization behavior in deciding the different assets/liabilities they will hold in their portfolios, taking into account the returns/costs. The set of equations that result are linked to the real sector via investments/savings equations, prices/returns and external/fiscal accounts.

In this regard, a first task will be to analyze in deep the theoretical structure of these models in order to include a set of equations that will represent the financial side that will be linked to the Exter or PEP 1.1 model.

But, as mentioned above, the model we propose and the novelty we want to incorporate is an endogenous devaluation mechanism (if possible). In most CGE models, devaluation is modeled as an exogenous shock where the nominal exchange rate is simply changed exogenously. In this case we want to modify this exogenous mechanism, by modeling the interaction of the different agents and determining the nominal exchange rate as a result of the demand and supply of dollars in the economy. A very preliminary schema following Thissen and Lensink (2001) could be:

Households and commercial banks determine their asset choice by maximizing utility from expected total asset earnings subject to the budget constraint, using a CES utility function as in Rosensweig and Taylor (1990). Household’s wealth is held in the form of domestic and foreign-currency (dollar) deposits, government assets, foreign assets, currency and shares issued by commercial banks.

Firms solve a similar maximization problem of households and finance their expenditures by retained earnings and by borrowing from the commercial banks.

The assets of the government are equity issued by commercial banks and the central bank, while its liabilities are bonds issued by itself, borrowing from the central bank, and foreign lending.

The assets of the commercial banking sector are: government assets, loans to production sectors, required reserves, excess reserves and net foreign assets. The liabilities include domestic currency, foreign-currency deposits, loans from the central bank and equity. It is assumed that commercial banks cannot earn profits, thus the deposit rate is endogenous determined.

Finally, the central bank lends to commercial banks and the government and holds foreign assets (international reserves) and has liabilities in the form of required reserves and currency. The central bank is key to incorporate the endogenous mechanism of devaluation in the CGE model.

Following Krugman (1979) approach for a Balance-of-Payment crisis, we will try to endogeneize the devaluation mechanism according to the following steps:

1. Start from a baseline scenario where the nominal exchange rate is fixed and the central bank has a given level of international reserves.
2. The economy has twin deficits, i.e. it has a fiscal and a trade deficit. In that situation, the economy is not able to generate foreign exchange, thus the central bank cannot accumulate international reserves. Foreign assets in the central bank are fixed.
3. According to the Exter model, the nominal exchange rate affects the price of the imported commodity $t$ and this price is part of the purchaser price of the composite commodity $i$. This means that in a fixed exchange rate regime, the composite price of each sector will be pegged to the price of imports and so to the world price of imported products.
4. Therefore, prices will be stable and so money demand will be also stable. This means that according to the balance of the central bank (equation 1), the only way that the central bank can increase its lending is by reducing the international reserves (assuming that required reserves are also fixed).

$$IR + DG + DC = C + R \quad (1)$$
where IR are the international reserves, DG is lending to the government, DC is lending to commercial banks, C is currency or monetary base and R are the required reserves.

5. But it is known that to maintain a fixed exchange rate regime, the Central Bank needs to use its international reserves to keep market for dollars balanced. So, we are going to run different simulations by increasing the loans from the Central Bank to the government and see how it affects the level of international reserves.

6. One of these simulations will be a case where international reserves are exhausted and so there is no other option to devaluate the nominal exchange rate.

7. Certainly, by looking at the government budget, it is seen that the government can use foreign lending. Therefore another set of simulations can include the possibility to increase the foreign lending or to issue bonds.

8. In general, when the international reserves are endogenous, the nominal exchange rate is exogenous and when the international reserves are exogenous, the nominal exchange rate is endogenous. This switching is another option frequently used for many countries.

Lastly, the real part will be also modified to better reflect the conditions of the Bolivian labor market. We are particularly interested in understanding how employment moves between sectors and how it impacts on poverty, given that some sectors have benefited more than others through the boom of commodity prices. Given that the informal (usually unskilled) workers have benefited more, this will require a review of the assumptions of the imperfections of the Bolivian labor market in the CGE models (which are usually ad hoc) by considering that the literature of the partial equilibrium analysis have important advances in this matter for the Bolivian case (see Muriel and Machicado, 2013, Herrera, 2017, and Herrera and Muriel, 2017).

We will adopt a micro-macro simulation approach because, as mentioned above, labor earnings are highly related to poverty reduction (which is measured in Bolivia by considering household’s income). In this regard, we will evaluate what has been done in the Bolivian literature, described above, as well as the in the international literature, to determine the best approximation.

A previous international literature review shows that alternatives to integrate CGE models with MSM techniques can be summarized into two categories: where the micro-simulations are integrated directly into the CGE modeling scheme; and where both models are estimated separately and then combined with interfaces (see Decaluwé et al. 1999, and Savard, 2003, 2005, 2010, Bourguignon et al., 2005, Cockburn et al. 2002, 2010, 2015).

**Second phase**

The second phase consists on the application of the model developed in the first phase to Bolivian data. If we want to simulate a situation where the economy has twin deficits and international reserves are falling, because the government is financing its deficit (or expenditures) with loans from the central bank, we need to use a SAM from 2016.

Therefore, once we have the theoretical model we will work on building up a 2016 real SAM based on the 2012 real SAM built for the Bolivian economy by Jemio et.al. (2015) for IFPRI. For this task we will have the advice from Luis Carlos Jemio, who works as senior researcher at INESAD.

To incorporate the financial side to the real SAM and so end up with a real-financial SAM we will review the literature (local and international). But, we think that once we have closed the links between the real and financial part of the model, this should not be a difficult task as monetary and financial data is easy to find in Bolivia.

**3.3. Data requirements and sources** (max 400 to 700 words)
This is a critical part of the proposal. The key issue is to explain the reason for the choice of your particular databases. You must establish that they are ideal for the question you wish to address and that you have or will have access to these data before your project begins. Please consult the “Guide for designing a research project proposals” for more detail.

The CGE model to be used in this research project will be based on a very detailed Social Accounting Matrix for the Bolivian economy. In 2014, INESAD, together with the International Food Policy Research Institute (IFPRI), participated in a research project aimed at building a 2012 SAM for the Bolivian economy, for the study of Agriculture and Income Distribution Issues (http://www.ifpri.org/publication/bolivia-social-accounting-matrix-2012). The 2012 SAM includes considerable disaggregation of economic activities, labor, and households by ecological zones, gender, ethnicity, geographic location (urban-rural), and income quintiles. In the construction of the 2012 Bolivian SAM, different data sources were used, including the 2012 National Census of Population and Housing, household surveys, national accounts, I-O table for 2012, balance of payments, various fiscal balances, and other more detail information on sectoral activities. Therefore, as we are much familiarized with this 2012 SAM and one of the authors of that SAM, which is Luis Carlos Jemio, works at INESAD, this is going to be the starting point to build an updated 2016 SAM. Almost all the information that is needed to update this SAM is available in the National Accounts, fiscal accounts and balance of payment accounts. In fact, most of the data is now available and compiled by the Ministry of Economy and Public Finances. Carlos Gustavo Machicado has worked also with the PEP 1.1 standard model and a Bolivian SAM for 2006. This model has been modified to incorporate characteristics of the Bolivian economy. In particular the equations for international trade, government consumption, private and public investment were modified. A wage curve was also introduced to model endogenous employment, as the PEP 1.1 assumes full employment. The PEP 1.1 model is static, but there is the PEP 1-t model that is recursive dynamic and could be also used in this research project. We will evaluate that after working with the Exter model first.

Beatriz Muriel has worked with some CGE models used for policy advice at the Ministry of Finance. In particular she has given advice on how to include taxes and fiscal evasion, but she is mainly familiarized with the macro-micro links related to labor variables.

As mentioned before the paper of Schweickert, et. al. (2005) is the closest to our idea, because it employs a real-financial CGE model for a dollarized economy like Bolivia. In their model they distinguish between commercial banks and the Central Bank as financial institutions. Beside the financial assets and liabilities accumulated in the domestic banking system (cash holdings, deposits, and loans), private and public enterprises have the possibility to accumulate a considerable amount of FDI, the government can acquire external debt, and some agents (employees, employers, public and private enterprises) can hold limited amounts of shares in domestic enterprises. Given that the aim is to analyze the impact of devaluation in a dollarized economy, the net dollar asset position of economic agents (households, workers, government, financial institutions, etc.) is of particular importance. We will calibrate the model to capture which agents are the main creditors and debtors in local and foreign currency and how their transactions relate. For this task we will employ the financial accounts from the Monetary System that includes the banking system accounts and the Central Bank accounts. Social Accounting Matrices (SAM) that include both the real and the financial components of the economy are relatively new and developed to perform a complete analysis of the economy. They are called Financial Social Accounting Matrix (FSAM) and have been built for different countries (see Emini and Fofack, 2004 for Cameroon; Hernández, 2008 for Colombia; Waheed, 2008 for Pakistan; and Li, 2008 for China, among others). Wong et.al. (2009) discuss the outlines and constructions framework for building an aggregate FSAM. The understanding of the structure of an FSAM can be a database for a financial Computed General Equilibrium (CGE)
model and can be used to analyze the behaviour of national’s public debt. The concepts, the construction and the theoretical framework that they present will be a starting point for building a Bolivian FSAM. But certainly this FSAM will include the currencies, deposits, bonds, and loans held by household, enterprises, commercial banks, the Central Bank, government, and the rest of the world.

The financial SAM scheme of Hernández (2008) seems to be appropriate to have a first view of the macro-financial relationships of the Bolivian economy. Certainly, we need to investigate more, especially if we want to introduce the possibility that banks have liabilities and assets in foreign currency (dollars). In addition, as we want to model informal producers, we need to introduce some constraints in their access to credit.

Finally, in order to carry out microeconomic analysis through micro-simulation techniques (MSM), a complete set of databases is available, including updated household surveys, population and agriculture census for 2012. In this regard, we have to mention that INESAD members have vast experience working with these types of databases. For instance, in the EMINPRO-INESAD Network it is possible to find more than 200 labor indicators from 1999 and 2014, which were processed using household surveys, census and others (see www.eminpro-inesad.com).

In the appendix, we present the macro SAM with its real and financial structure that incorporates the insights from other SAM’s which are also public available and that are going to be our starting point to build a 2016 FSAM (see Thiele and Piazolo, 2002, 2003 and Canavire and Mariscal, 2010).

SECTION IV – POLICY ENGAGEMENT

4.1. Policy relevance

4.1.1. Describe policy context and needs

Describe the specific policy issues or needs that your research aims to address; how your potential outcomes and findings may be used in policy making? Please be as precise as possible, indicating specific current or prospective policies and the specific contributions your research would make.

Also, justify timing of your research in terms of policy and socioeconomic needs and context – e.g. reference to existing, planned or potential policies at the national, regional or local level; specific political context; international examples of similar policy problems or solutions, etc.

The proposed investigation is very relevant to the current situation that the Bolivian economy is experiencing, for several reasons:

First, the fixed nominal exchange rate policy seems unsustainable in the current situation, characterized by a growing current account deficit and declining international reserves. Remember that international reserves are key to maintaining a fixed nominal exchange rate, because with them the Central Bank can intervene in the dollar market, provided there is a demand that presses up the price of the dollar.

Second, the fixed nominal exchange rate policy has been determinant in de-dollarizing the economy or "bolivianizing" it, and this has allowed the Central Bank to recover many important monetary policy instruments to influence economic activity. In fact the financial system has been revitalized through deposits and credits in local currency, which in turn has boosted domestic...
demand and this has boosted also economic growth.

Third, a key element explaining economic growth in recent years is macroeconomic stability reflected in a controlled inflation rate of less than 5%. This is precisely because inflation is anchored to the fixed exchange rate and any upward pressure on prices due to the scarcity of some commodities is easily controlled by imports. And as the real exchange rate (RER) is overvalued, imported goods are cheaper.

Fourth, there is some evidence that bolivianization has allowed the government to have at its disposal the seigniorage as a source of financing for public expenditure, investment and public enterprises. Recently many public enterprises benefited from credits of the Central Bank. Therefore, in the current conditions where there is also a growing fiscal deficit, losing that source of financing could be risky.

For all these reasons, an important debate of the current economic policy in Bolivia is precisely whether or not the nominal exchange rate should be relaxed, that is, to devalue it, as many neighboring countries did. In fact, the devaluation of many countries that are Bolivian trading partners has accentuated the problem of overvaluation of the real exchange rate. There is some pressure from the export sectors to change the exchange rate policy.

As far as we are aware, neither the Central Bank nor UDAPE nor the Ministry of Economy and Public Finance have an updated CGE model that could be used to test different macroeconomic scenarios in the face of a change in the exchange rate policy. Therefore, having a CGE model, that allows performing this analysis and quantifying the effects on the growth of the sectors, the labor market and the financial system, will be crucial in guiding public policy in Bolivia.

Moreover, as the model proposed seeks to endogeneize the process of devaluation of the local currency, it also allows quantifying the extent to which it is possible to withstand this policy of fixed exchange rate and if a gradual adjustment could be incorporated in order to prevent dramatic consequences for the economy.

### 4.1.2. Consultations to date

List the consultations that you have had with potential research users (e.g. policy makers or stakeholders) and that have helped define your research question, and/or informed you of the specific policy context described above.

For each institution consulted, please:

- List key (individual) representatives who participated in the consultation
- Describe the main outcome(s) of the consultation (feedback, inputs, etc.)

<table>
<thead>
<tr>
<th>Name of institution/organization #1</th>
<th>Bolivian Catholic University</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>List the key representative involved in consultations (names and titles/positions)</strong></td>
<td></td>
</tr>
<tr>
<td>Juan Antonio Morales (former President, Central Bank of Bolivia)</td>
<td></td>
</tr>
<tr>
<td><strong>Describe main outcomes of consultation – feedback or inputs received</strong></td>
<td></td>
</tr>
</tbody>
</table>

The exchange rate is a key variable in a small open economy and tracking its effects throughout the economy with a Computable General Equilibrium Model is very appealing. Bolivia has been following a de facto fixed exchange rate policy since November 2011. During the commodity boom of 2004-2013 the government of Bolivia preferred to accumulate international reserves rather than to revalue the currency. After the price crash of commodities that started in mid-2014, the government has kept the parity to the dollar, notwithstanding the loss of about 40% of exports between then and 2016, and the fact that the main trade partners in the region have
depreciated their currencies to cope with the crisis. These exogenous shocks have overvalued the domestic currency. Computations with different methodologies, some of them undertaken by the Central Bank of Bolivia, and by independent researchers suggest an overvaluation between 20% and 40%. The policy implications of this proposed study are very clear.

<table>
<thead>
<tr>
<th>Name of institution/organization #2</th>
<th>KAS Konrad Adenauer</th>
</tr>
</thead>
<tbody>
<tr>
<td>List the key representative involved in consultations (names and titles/positions)</td>
<td>- Iván Velasquez (Bolivian coordinator)</td>
</tr>
<tr>
<td>Describe main outcomes of consultation – feedback or inputs received</td>
<td>In 1985 a crawling peg regime was implemented to make the exchange rate competitive with respect to a basket of currencies and favoring the export sector in generating value added. In 2011, the statist model established a fixed exchange rate that brought mixed results for the Bolivian economy. First a fixed exchange rate facilitated monetary policy and did not demand fundamental macroeconomic balances; second, it penalized competitiveness of the export sector and favored the increase of imports to the economy. After several years, evaluating this results and analyzing them from a general equilibrium perspective is highly relevant since in an ex post boom scenario it is important to rethink public policy measures in the exchange rate field. The model will serve to identify the transmission mechanisms of monetary policy; therefore this research proposal is fully justified.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name of institution/organization #3</th>
<th>IADB – Bolivian Office</th>
</tr>
</thead>
<tbody>
<tr>
<td>List the key representative involved in consultations (names and titles/positions)</td>
<td>- Javier Beverinotti (Country economist)</td>
</tr>
<tr>
<td>Describe main outcomes of consultation – feedback or inputs received</td>
<td>The nominal exchange rate has not changed since November 2011, which has allowed the country to progress in the de-dollarization of the economy, to control the imported inflation, to anchor expectations and to have greater action with the monetary policy. However, it has also led to a real exchange rate appreciation which, sooner or later, will lead to a currency realignment. In this sense, the proposal to develop a computable general equilibrium model becomes relevant because it will allow the identification of the impact of the exchange rate alignment on important variables such as saving and credit, foreign trade, growth, wages and prices.</td>
</tr>
</tbody>
</table>

4.2. Engagement strategy

4.2.1. Identify target audiences

Identify potential users of your research findings – institutions/organizations that may use your findings to inform, advise or influence policy or other relevant decision-making processes. Please explain why you believe these institutions/organizations are the most important potential users of your research, to inform relevant development/policy decisions.

<table>
<thead>
<tr>
<th>Name of institution/organization #1</th>
<th>Central Bank of Bolivia (BCB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explain relevance of this user to inform key decisions</td>
<td>The exchange rate policy is part of the monetary policy. Therefore the decision to relax the exchange rate policy depends mainly on the Central Bank. Its president and directors will be glad to see numbers about the impact of this potential change in its policy, and suggestions</td>
</tr>
</tbody>
</table>
about what could be the optimal way to implement it.

<table>
<thead>
<tr>
<th>Name of institution/organization #2</th>
<th>Unit of Economic and Social Policy Analysis (UDAPE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explain relevance of this user to inform key decisions</td>
<td>This Unit dependent of the Ministry of Development Planning has experience on CGE modeling and they have used different CGE models to inform and advice public policy in the past. They would be glad to learn from the results of this analysis and also the novelties introduced could inspire the update of their models for future research. They also have experts on SAM, so the interaction with them will be important.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name of institution/organization #3</th>
<th>National Institute of Statistics (INE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explain relevance of this user to inform key decisions</td>
<td>The data used to build the SAM will come mainly from this institution, therefore this research will guide their technicians which data has to be updated in order to have the most recently results. The household survey´s used in the micro simulations come also from INE, and according to their representativeness we will use one or more surveys.</td>
</tr>
</tbody>
</table>

4.2.2. Define outreach and engagement strategy

How, from proposal design to the dissemination of your research results, will you consult and communicate with these users to both gather their inputs and keep them informed of your project, in order to increase chances of research uptake?

We plan to organize an advisory group made up of experts on macroeconomics and national accounts from the Bolivian Central Bank, UDAPE, INE, the Ministry of Economy and Public Finance and the Ministry of Development Planning. This advisory group will meet once a month to monitor the advance of the project. As they are very busy people, in each meeting a presentation will be done in order to receive their feedback. If needed, specific meetings with one or some of the experts will be arranged to discuss a specific topic. For example, the correct structure of the SAM will be discussed with the expert from UDAPE, who has ample experience on input-output matrix. We will organize workshops to have internal discussions with invited people, in particular academics from other research institutions or universities.

4.2.3. Outline your preliminary dissemination strategy

Outline your preliminary dissemination strategy (channels, tools, events, audiences, etc.).

Note that PEP expects grantees to disseminate information about their research work and (expected) outcomes throughout the project cycle, and not only after publication.

INESAD foundation is the leading research institution in Bolivia with the mission to impact in public policy through our research. Therefore INESAD takes part in many networks through which we disseminate our research. As every year we will organize an economic symposium where we will invite policymakers, academics, students, international organizations´ representatives, etc. to present the results of the research. Our researcher will take part on national and international
seminars and conferences, like the Bolivian Conference on Development Economics or the LACEA meeting, where the paper will be submitted. Recently we have started using the social networks like Facebook and Twitter to discuss actual economic issues. We can present the results through info graphics to motivate some discussion. We plan to organize also presentations for the main authorities of the institutions involved in the advisory group.

SECTION V – OTHER CONSIDERATIONS

5.1. Describe any ethical, social, gender or environmental issues or risks that should be noted in relation to your proposed research project.

There is no ethical, social, gender or environmental issues or risks related to this research project. Bolivia is a democratic country, so everybody is free to express his opinion and to develop his ideas in a scientific way, as this research is going to be.

5.2. References and plagiarism:

Applicants should be very careful to avoid any appearance of plagiarism. Any text of five or more consecutive words that is borrowed from another source should be carefully contained between quotation marks with a reference to the source (including page number) immediately following the quotation. It is essential that we be able to distinguish what you have written yourself from what you have borrowed from elsewhere.

Note also that copying large extracts (such as several paragraphs) from other texts is not a good practice, and is usually unacceptable. For a fuller description of plagiarism, please refer, for example, to the following website:

- [http://writing.yalecollege.yale.edu/advice-students/using-sources/understanding-and-avoiding-plagiarism](http://writing.yalecollege.yale.edu/advice-students/using-sources/understanding-and-avoiding-plagiarism)

PEP will be using a software program to detect cases of plagiarism.


Appendix

Structure of the real SAM

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<th>8</th>
<th>9</th>
<th>10</th>
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</thead>
<tbody>
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<td></td>
<td>Activities</td>
<td>Commodities</td>
<td>Factors of production</td>
<td>Households</td>
<td>Enterprises</td>
<td>Taxes</td>
<td>Government</td>
<td>Saving-investment</td>
<td>Rest of the world</td>
<td>Total</td>
</tr>
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<td>1</td>
<td>Activities</td>
<td>Domestic supply</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total revenue</td>
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<tr>
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<td>Commodities</td>
<td>Intermediate demand</td>
<td>Household consumption</td>
<td>Government consumption</td>
<td>Investment</td>
<td>Exports</td>
<td>Total demand</td>
<td></td>
<td></td>
<td>Factor income</td>
</tr>
<tr>
<td>3</td>
<td>Factors of production</td>
<td>Value added</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Household income</td>
</tr>
<tr>
<td>4</td>
<td>Households</td>
<td>Wages</td>
<td>Transfers</td>
<td>Transfers</td>
<td>Transfers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Household income</td>
</tr>
<tr>
<td>5</td>
<td>Enterprises</td>
<td>Profits</td>
<td>Transfers</td>
<td>Transfers</td>
<td>Firms' incomes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Taxes</td>
<td>Import tariffs &amp; indirect taxes</td>
<td>Direct taxes</td>
<td>Direct taxes</td>
<td></td>
<td></td>
<td>Tax payments</td>
<td></td>
<td></td>
<td>Government revenues</td>
</tr>
<tr>
<td>7</td>
<td>Government</td>
<td></td>
<td>Tax receipts</td>
<td>Transfers</td>
<td>Government revenues</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Saving-investment</td>
<td>Household savings</td>
<td>Firms' savings</td>
<td>Government savings</td>
<td>Foreign savings</td>
<td>Total savings</td>
<td></td>
<td></td>
<td></td>
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</tr>
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<td>9</td>
<td>Rest of the world</td>
<td>Imports</td>
<td>Transfers</td>
<td>Transfers</td>
<td>Transfers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Payments to RoW</td>
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<tr>
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<td>Total</td>
<td>Total cost</td>
<td>Total supply</td>
<td>Factor income</td>
<td>Households' outlays</td>
<td>Firms' outlays</td>
<td>Total taxes</td>
<td>Government's outlays</td>
<td>Total investment</td>
<td>Payments from RoW</td>
</tr>
</tbody>
</table>

22
### Structure of the financial SAM

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Households</td>
<td>Enterprises</td>
<td>Government</td>
<td>Domestic banks</td>
<td>Rest of the world</td>
<td>Central Bank</td>
<td>Accumulation</td>
<td>Total</td>
</tr>
<tr>
<td>1</td>
<td>Households</td>
<td></td>
<td></td>
<td>Household’s deposits</td>
<td>Deposits abroad</td>
<td>Demand for money</td>
<td>Household’s portfolio</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Enterprises</td>
<td></td>
<td></td>
<td>Firm’s deposits</td>
<td></td>
<td>Private investment</td>
<td>Firm’s expenditures</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Government</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Government’s surplus or deficit</td>
<td>Government’s requirements for loans</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Domestic banks</td>
<td>Loans to households</td>
<td>Loans to firms</td>
<td>Loans to government</td>
<td></td>
<td>Domestic reserves</td>
<td>Bank assets</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Rest of the world</td>
<td>Foreign loans to households</td>
<td>Foreign loans to firms</td>
<td>Foreign loans to government</td>
<td>Foreign loans to domestic banks</td>
<td></td>
<td>FDI</td>
<td>Foreign bank assets</td>
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<tr>
<td>6</td>
<td>Central Bank</td>
<td></td>
<td>Loans to public sector</td>
<td>Rediscout operations</td>
<td>International reserves</td>
<td></td>
<td>Central bank assets</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Accumulation</td>
<td>Household’s savings</td>
<td></td>
<td>Retained profits</td>
<td></td>
<td></td>
<td>Total savings</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Total</td>
<td>Household’s savings</td>
<td>Firms’ funding</td>
<td>Loans to government</td>
<td>Bank liabilities</td>
<td>Current account surplus/deficit or foreign banking sector liabilities</td>
<td>Central Bank liabilities</td>
<td>Total investment</td>
</tr>
</tbody>
</table>