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LANDLOCKED COUNTRIES, INSTITUTIONS AND ECONOMIC DYNAMICS

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ABSTRACT

This study moves away from the use of conventional methods such as standard regressions to evaluate the hypothesis of a negative effect of a landlocked country on economic growth and other variables. An alternative approach was used based on a dynamic stochastic general equilibrium model (DSGE). The main estimation reflected a *permanent shock* of -2% on *Non-Maritime Gross Domestic Product*. To this end, the model was calibrated with parameters of the Bolivian economy (landlocked country) and the presence of similar behavioral economies with sea presence in observational equivalence (comparative countries) for impact evaluation purposes. Likewise, the role of institutional quality represented approximately 20% in the variability of the country's aggregate production (GDP), with the inference that institutional innovations could reduce and mitigate by 68% the negative effect of being a landlocked condition (mitigating action and structural challenge).

Contribution/ Originality: The paper's primary contribution is the finding of a -2% permanent effect on GDP of being a landlocked country that could be reduced and mitigated by 68% by institutional innovations. The method used was a DSGE model, moving away from standard regressions identified in the existing literature.

1. INTRODUCTION

Adam Smith was the first to point out and link the existing pattern between the *inland* geographical areas (landlocked countries) and its association with lower levels of development in 1776 (Faye *et al.*, 2004). On the other hand, from a total of 182 countries, it was observed that 38 were landlocked – without access to the sea (approximately 20% of the total) – and that the remaining percentage had a sea coast. It has also been shown that less than 10% of the countries that are landlocked, are part of the first quartile in the classification of high income countries (Lahiri and Masjid, 2012; Feenstra *et al.*, 2015; Fulk, 2017).

As a result, there are only four landlocked countries with the highest levels of per capita income by their respective ordinance*: Luxembourg, Switzerland, Austria and the Czech Republic*: with incomes above USD 25,000 per inhabitant (in comparative US dollars at constant 2011 prices, Purchasing Power Parity, PPP).

Previous studies using a conventional and generalized approach in the use of standard regressions or gravitational models, established a negative relationship (penalty) between the impact of being a landlocked country

on growth and the economic dynamics of the affected countries (Head *et al*., 2010; Paudel, 2014; Moore, 2017). In addition, it had implications with greater deterioration in the institutional quality (for example, in the level of corruption (Dollar and Kraay, 2003; Carmignani, 2015) when contemplating longitudinal or cross-section data through the use of dichotomous variables (1 = landlocked, 0 = with access to the sea).

Therefore the purpose of this study is to answer two research questions: What is the impact of the landlocked shock on the economic dynamics of a country? How can the impacts of being a landlocked country be mitigated?

In order to answer the questions, two main premises were proposed: i) the *shock* of landlocked generates a negative and permanent impact on *Non-Maritime Goods and Services* (production and consumption of a landlocked country); ii) the institutional response mechanism is the structural challenge to mitigate or counteract the condition of being a landlocked country, which would imply the following: landlocked countries with positive institutional innovations, such as *proxies* with higher institutional quality (higher index) and reduction in the negative impact it has on economic dynamics, resulting from the shock of the landlock, whose proposal is contrary to the empirical evidence in previous studies.

The academic discussion (theoretical, empirical and application for public policies) focuses on how to neutralize the negative effects of being a landlocked country: Why are few economies successful? Why do most landlocked countries have retarding effects on their economic dynamics?

A fundamental premise was considered based on Carmignani (2015) previous contribution, when considering the role of institutions as the main factor before other comparisons (e.g., international trade); or the approach of Mehlum *et al*. (2006) where institutions, in reality, are the main factor to consider, while determining the curse or blessing of natural resources or the applied inference in the case of landlocked countries (the first decile or countries of the last decile of income).

In answering the raised questions, an alternative and a different approach has been obtained from previous studies conducted on being a landlocked country; but this time, a model of general equilibrium, dynamic and stochastic, with the base in calibration of the Bolivian economy was used and parameters of economies in observational equivalence were taken as counterfactual cases (with access to the sea) (fourth country in the region of South America). This is the first study to evaluate the subject under this approach.

Consequently, the study consists of four sections: the first one deals with a brief review of the literature about the quantification of the impacts of being a landlocked country; the second one provides the development of a general, dynamic and stochastic equilibrium model of type 2x2x2; the third section comprises the results of the simulation and respective quantification of impact; the fourth section reflects the discussion of the study. At the end of the study, the main conclusions are discussed.

1.1. Brief Literature Review: Landlocked Countries, Institutions and Economic Dynamic

The neoclassical theory of endogenous growth, linked to geographical location, maintains that those countries with a higher degree of being landlocked will have lower economic growth compared to countries with maritime access, and that as a result, their connection with nearby countries for transit and commercial connectivity, transport and logistics costs, infrastructure investments and foreign policy was highlighted (Fulk, 2017).

The different opinions complement each other as multivariate lenses and theoretical approaches are linked to economic geography (e.g., neighborhood theory, landlocked theory, new trade theory, among others) and as a consequence, in terms of economic growth, countries that are landlocked grow to a lesser extent (between -1 and -2% of GDP, according to longitudinal studies of maritime countries) and without direct access to the sea, respectively (MacKellar *et al*., 2002; Paudel, 2014).

On the average, the impact of landlocked countries to the maritime coast, in comparison with countries with sovereign access, ranges from -51% on international trade (Head *et al*., 2010) even to -80% (Raballand, 2003). On

the other hand, there is a pattern of association between landlocked and its positive relationship with dependence on natural resources (Hance, 1975; Arvis *et al.*, 2010; Sharma and Davaakhuu, 2015)[1] which fall under the so-called *natural resource curse hypothesis* (Sachs and Warner, 1995) or in this case, *double curse* (landlocked and dependent on natural resources); although, such a curse did not originate from geographical condition, nor from the abundance of natural wealth, but by the negative role played by institutions (Mehlum *et al.*, 2006).

Similarly, it was argued that the countries in the condition of being a landlocked have a negative impact on the quality of their institutions in-7% (Carmignani, 2015) or with an incidence of-21% in the quality of the index of the rule of law (Dollar and Kraay, 2003) whose indicators are associated with a deterioration in the restrictions of government power, increased levels of corruption, closed governments, violation of human rights, order and security, as well as affecting the quality of civil and criminal justice.

In this regard, since the seminal contribution of Olson (1982) and North (1990) based on the importance of institutions with impact either positively or negatively on the dynamics of countries (Knack and Keefer, 1995). These variables are reflects on *institutional quality*: democracy (Comeau, 2003; Rock, 2009; Narayan *et al.*, 2011) political stability (Barro, 1991; Aisen and Veiga, 2013) property Rights (Tornell and Velasco, 1992; Peev and Mueller, 2012) civil and political freedom (Kormendi and Meguire, 1985; McMillan *et al.*, 1991).

1.2. 2x2x2 Adapted Models to One Landlocked Country

For this study, the peculiarity of the *2x2x2 model* is characterized by its adaptation and originality from a non-conventional approach in comparison with previous studies, from the context of being a landlocked country and institutional quality to a small and open economy, as is the case of Bolivia, with a dynamic, rather than static component. In order to achieve this, some central assumptions were considered, as indicated below:

i. There are two types of consumers*: maritime families* and *non-maritime families* respectively, represented by their utility functions.
ii. Only two types of goods are produced: *maritime product* (fishing sector and maritime industry) and *non-maritime product* (traditional sectors of a landlocked country or other non-maritime activity). There are individual production functions, independent of productivity or a given level of technology for each process.
iii. There are *two productive factors* for each type of good: work and physical capital stock, distinguishing the maritime from the non-maritime sector; therefore, there are differentiated costs (wages and return on capital).
iv. The objective of the families is the maximization of their social welfare functioning as a utility function subject to a budgetary restriction.
v. The firms' objective is to minimize production costs, subject to the restriction of their production function, respectively.
vi. There are price rigidities, for each type of good, in the sense that there are differentiated Phillips Neo-Keynesian curves.
vii. There is a central bank that operates using a Taylor monetary rule and a money growth function.
viii. Exogenous *shocks* are assumed to have repercussions as disturbances along the economic structure in dynamic mechanism (institutional landlocked, *maritime productivity shocks*, currency exchange policy, among others).

[1] Two reference examples can be mentioned: Bolivia in Latin America with a concentration in hydrocarbon and mineral exports, exceeding 70% of the total Banegas, Ramírez and Caba, (2017) and the case of Mongolia in Asia, as one of the mining countries with the world's largest reserves Sharma and Davaakhuu, (2015).

ix. The parameters of the model were calibrated for an economy with landlocked (example with Bolivia) and are considered counterfactual parameters of similar countries that have access to the sea Figure 1: Colombia, Ecuador, Peru and Bolivia.

x. There is the presence of a government (with counterfactual income from additional taxes to imports).

xi. An external sector is considered to be directly linked to the incidence of landlocked countries and the interrelationship between landlocked countries, the quality of institutions and economic growth.

For the points viii to xi, these countries were considered for three fundamental reasons: there is a similar characterization in geographical context (South Pacific Zone), they are small economies and away from the main international financial markets, and they present a similar economic structure as explained in Appendix 1.

Finally, the *shock of being a landlocked country* is interpreted as an exogenous disturbance, in terms of distance and time in accessing the Pacific coast (Faye *et al*., 2004).

Comparative countries with Bolivia: Counterfactual with the sea
(Colombia, Ecuador, Peru and Chile)

Figure-1. Comparative countries for parameters and counterfactual variables (fictitious simulation of a landlocked country with sea, the Bolivian Case).Observational equivalence: South Pacific Zone.

Consequently, the standard version of general equilibrium models, dynamic and stochastic (DSGE), in log-linearized version, was followed with decisions of inter-temporal optimization, price and wage rigidities, Taylor's monetary policy and monetary growth, as well as the inclusion of adjustment costs in their investments (Benigno and Woodford, 2003; Smets and Wouters, 2003; Christiano *et al*., 2005).

In this regard and as stated in Appendix 2, the key parameters to evaluate counterfactual impacts on relations were: institutional landlocked, institutional quality and economic growth in the context of access to the sea (Maritime Economies), Maritime landlocked (Non-Maritime Economies) and the structural challenge in mitigating the condition of being landlocked as listed in Table 1.

Table-1. Counterfactual impact evaluation and sensitivity.

(Economy with access to the sea, Non-maritime and with structural challenge to mitigate the condition of being Landlocked)

	Parameter	a) Maritime **Economy** (with access to the sea)	**Non-Maritime Economy** (Being a Landlocked country)	b) **Structural challenge**[ζ] (Mitigation of being a Landlocked country)
Effect of the landlocked condition on economic growth	θ_{Yl}	0.00	-0.00698	+0.00698
Effect of the landlocked condition on the trade balance	θ_{TB}	0.00	-0.51	+0.51
Effect of the landlocked condition on the quality of institutions	θ_{CI}	0.00	-0.073	+0.073

Note[ζ]It is constituted based on analysis of sensitivity.
Source: Based on author´s review and empirical evidence (Dollar and Kraay, 2003; Head *et al.*, 2010; Paudel, 2014; Carmignani, 2015).

Consequently, the parameters were considered and calibrated for those economies with opens access to the sea *(Maritime Economies*); by the contrary, a negative effect is expected for landlocked countries (*Non-Maritime Economies*) less economic growth, lower trade balance and worse institutional quality index, therefore, the structural challenge is constituted in a sensitivity analysis with opposite coefficients to the empirical evidence found in the mentioned literature of Table 1 (sources) for countries without access to the sea.

2. RESULTS OF THE MODEL DSGE

Previously, the simulated results were compared with the observed data for a non-maritime economy (an exemplified landlocked country by Bolivia) and Maritime Economies in observational equivalence (Colombia, Ecuador, Peru and Chile) in order to replicate the economic structures observed in the identified countries.

It was observed that the simulated and observed data came from the calibration of the parameters of the DSGE model, for the *Non-Maritime Economy* (Bolivian case) and for the *Maritime Economies*, in terms of Consumption, Investment and Expenditure of the government relative to the GDP and were compared with observed data from the period (1950 – 2014), as well as the steady-state inflation as shown in Table 2.

Table-2. Comparison of the simulated data (model DSGE) and observed data.

	Landlocked Economy		Maritime Economy	
	Simulated Data	**Observed Data**	**Simulated Data**	**Observed Data**
C/Y	0.65	0.63	0.65	0.68
I/Y	0.14	0.16	0.18	0.19
G/Y	0.17	0.17	0.17	0.16
S. Inf.	0.06	0.06	0.03	0.03

Note: Proportion of Private Consumption (C) in terms of Product (Y), Investment (Y), Government expenditures (G) and Stationary Inflation (S. Inf.).

According to Figure 2, a simulation of the model was observed between the interaction of greater deviation of the maritime landlocked (e.g., greater distance or time of access to the coast), linked with negative deviation in the investment. This would negatively affect, in greater measure, the real product.

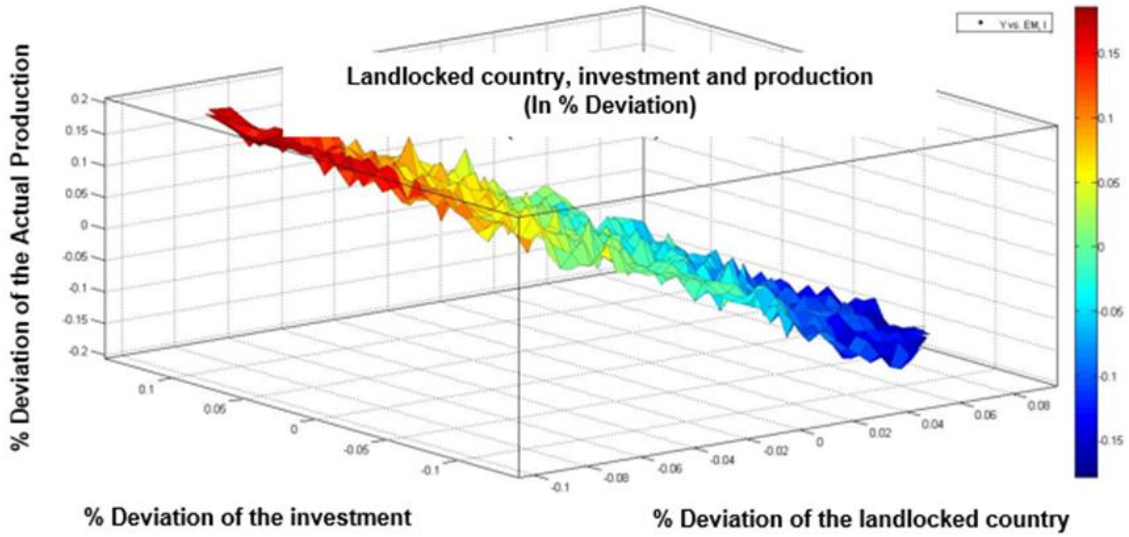

Figure-2. Landlocked country, investment and production (Simulation in % Deviation standard).

According to Figure 3, the simulation of the model was observed, where the positive deviation of the institutional quality, linked to the positive variability of the investment would be directly related to the variability in the growth of the real product of the real economy.

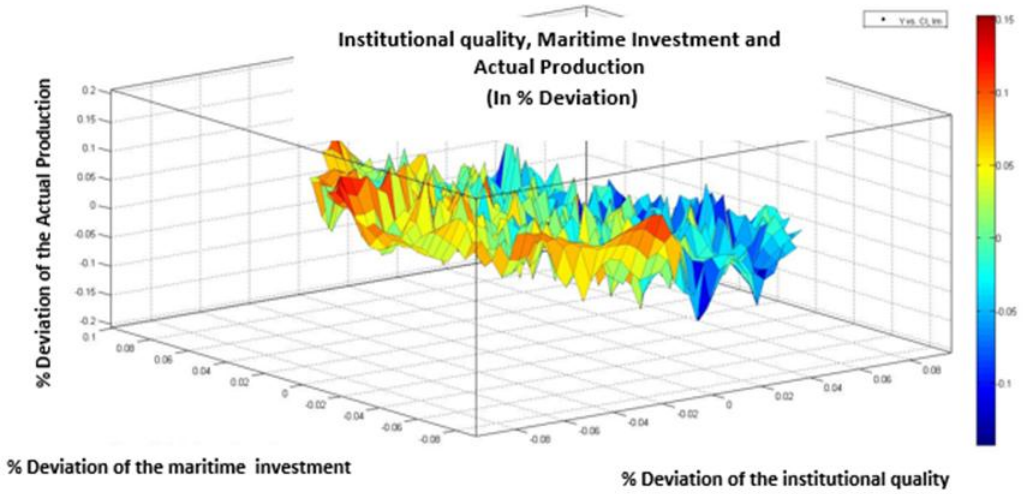

Figure-3. Institutional quality, maritime investment and production.(Simulation, in % Deviation standard).

In summary, the first results of the model allowed replication of the simulated data compared to the observed data, both for the *Non-Maritime Economy* (landlocked country) and for the *Maritime Economies* (observational equivalence) with approximate values. Similarly, it revealed that greater deviations from landlocked, with lower investment, would translate into negative deviations of the real product; in contrast, the interaction between positive deviations from institutional quality and investment would reflect the greatest positive deviations for the real product.

2.1. Relative Importance of the Maritime and Institutional Landlocked Shocks

According to the analysis of variance decomposition (see Appendix 4), the highest percentage incidence of the *shocks of the condition of being a landlocked country* was due to the explicability close to 80% of the aggregate product (Y_t), as the greatest source of variation, as well as the checking account (Cab_t). Likewise, the disturbances of the

landlocked caused about 40% of the variability in the Maritime Productivity (A_t^M), the Non-Maritime Productivity(A_t^{NM}), the Total private consumption (C_t), the Private consumption non-maritime (C_t^{NM}), the Aggregate investment (I_t), and Social Welfare (BS_t).

From the perspective of the *institutional role*, its innovations have a 50% impact on the net exports(XN_t), and close to 20% on aggregate production (Y_t) and on the current account(Cab_t). For other variables, such as private consumption(C_t), investment(I_t), fiscal balance (bf_t) and social welfare(BS_t), the relative importance of institutional shocks have about 10% variability.

In the case of *maritime and non-maritime productivity shocks* respectively, their relative shares were evident on themselves in the short term, as well as on consumption variables and on social welfare.

The role of *monetary policy innovations (via interest rates)* was highlighted, in their relative participation in total and non-maritime private consumption $(C_t y C_t^{NM})$, non-maritime investment (I_t^{NM}), financing structure (bonds) (B_t), public debt (*D*) and fiscal balance (bf_t), in an average interval between 30 and 40% of explanatory variables for a horizon of 5, 10 and 20 periods, respectively.

Finally, another type of relevant innovation focused on the *perturbations of production costs*, which have an impact with a variability close to 80% on maritime and non-maritime production $(Y_t^M y Y_t^{NM})$, as well as a variation source of 35% on total consumption (C_t) over a five-year period. In a consistent and time-independent manner, the disturbance of production costs accounts for between 70 and 80% of the variability of the country risk premium.

2.2. Effects of the Landlocked Country and the Role of the Institutions

2.2.1. The Shock of the Landlocked Country

According to an hypothesis, in countries with the condition of being landlocked, a *negative shock* was expected to have a negative and permanent effect on the Non-maritime product (Y_t^{NM}), as well as on aggregated non-maritime investment (I_t^{NM}),), non-maritime private consumption (C_t^{NM}), real monetary balances (m_t^r) and social welfare (BS_t). This evidenced reflected empirical support according to the impulse-response functions shown in Appendix 5A.

Indeed, because of the landlocked condition, there was a permanent -2% annual *shock* on the non-maritime product(Y_t^{NM}), with the same severity for both the private consumption of non-maritime families (C_t^{NM}), and for social welfare (BS_t); -7% on the aggregate non-maritime investment (I_t^{NM}); and finally, an impact of -6% on the real monetary balances (m_t^r).

On the other hand, temporary shocks were identified as impacting the total aggregate sector (-4%), aggregate production (Y_t), Total aggregate investment$(I_t)$and private aggregated consumption (C_t) (-1%); fiscal balance (-5%), with effects that dissipated in the short-term.

2.2.2. Role of the Institutional Innovations

In the context of a landlocked country, an expected negative relationship arose from the institutional disturbances, which was reflected in the functions of imposed-response according to the *Appendix 5B* (according to the raised premise).

In this regard, the institutional innovations had a permanent impact on-1% of the non-maritime product(Y_t^{NM}), as well as on the private consumption of non-maritime families $(C_t^{NM})$and social welfare(BS_t); -5% on aggregated non-maritime investment(I_t^{NM}); -3% on actual monetary balances(m_t^r); but, a simulated temporal shock was observed on the fiscal balance (bf_t)in-2.5%, and the variables used are explained in *Appendix 6*.

2.2.3. Counterfactual Analysis: Mitigation of the Negative Impact

In the scenario of a response contrary to the empirical evidence found with a structural challenge for a landlocked country (sensitivity analysis), there would be: a) positive relationship between landlocked and institutional quality; b) positive relationship between institutional quality and economic growth (output per worker); c) positive relationship between landlocked and trade balance. According to Table 3, the shock of being landlocked and its permanent effects would be reduced or offset by a 68% metric (in the long term).

Table-3. Shocks of the landlocked country, with a change of institutional response, in the long term.
(Expressed in rate of change)

Simulation of impact in variables of interest	Base scenario	With change in institutional structural response (counterfactual)
Non-maritime production(Y_t^{NM})	-2	-0.7
Aggregate Non-maritime investment(I_t^{NM})	-8	-3
Non-maritime family's consumption(C_t^{NM})	-2	-0.7
Social welfare(BS_t)	-2	-0.7
Real monetary balances(m_t^r)	-6	-2

The long-term effect would decrease by 68% the various negative shocks on the non-maritime product, the non-maritime aggregate investment, the consumption of non-maritime families, social welfare and real monetary balances (see Appendix 5C).

Similarly, the effects of simulated institutional innovations showed a reversal from negative shocks to positive innovations in Table 4, considering an opposite change in the structural response of the country without sovereign access to the sea (landlocked and institutional quality; institutional quality and economic growth (output per worker); landlocked and trade balance).

According to Appendix 5D, the institutional innovations had permanent long-term effects, with mitigating actions as a reverse mechanism, though elastic or highly sensitive (average change is 1.3 times).

Table-4. Effects of institutional innovations, in a context of being landlocked, in the long term.
(Expressed in rate of change)

Simulation of impact in variables of interest	Base scenario	With change in institutional structural response (counterfactual)
Non-maritime production (Y_t^{NM})	-1.0	+3.0
Non-maritime aggregated investment (I_t^{NM})	-4.1	+1.1
Consumption of the non-maritime families (C_t^{NM})	-1.0	+0.3
Social welfare(BS_t)	-1.0	+0.3
Actual monetary balances (m_t^r)	-3.0	0.0

As a result, in the face of institutional innovations, the long-term response shifted from a negative shock to positive or near-zero innovations in macro aggregates.

3. RESULTS, DISCUSSION AND IMPLICATIONS OF PUBLIC POLICIES

Traditionally, previous studies have been linked to revealing strategic policies for the promotion and development of foreign trade (via investments and external relations), as a mitigation mechanism for the landlocked condition such as limiting restrictive export policies, offering reforms in export policy (e.g., reducing paperwork and bureaucratic export costs); transformations in the differentiated import regime and policy (lower tariffs for raw materials or capital goods); free trade or unrestricted import policies (without quotas); government subsidy for transport costs; among other strategies (Faye *et al.*, 2004; Normizan and Yasunori, 2014; Sharma and Davaakhuu, 2015).

As a result, the Ministerial Conference of Landlocked Countries and Transit of Developing Countries established the action program called APoA in 2003 (United Nations (UN), 2004) which established five lines of action to combat the negative implications of maritime restriction: 1) secure access to and from the sea in free transit; 2) reduce transport costs; 3) reduce delays and uncertainty in the trade route; 4) improve transport infrastructure with the support of international cooperation; and, 5) develop transport corridors in order to improve trade flow.

The APoA policies are based on the estimations found for the importance of production cost disturbances in productivity variability (*maritime and non-maritime*) which is close to 80% of explanation, especially in a period of five years and up and pointing out that independent of time; they exert the greatest source of variability (close to 70%) on the risk premium.

However, this document showed an empirical observance of compliance: *the shock of the maritime landlocked condition or the disturbance of distance from the maritime coast*, which causes a negative and permanent effect on the non-maritime goods and services of a landlocked country (production and consumption), as well as identifying itself as the greatest source of variability compared to other explanation factors.

However, we can disagree with the existence of countries with the lowest per capita income (at purchasing power parity), which correspond in open access to the sea coast (e.g., Madagascar, Mozambique, the Congo or Liberia); or three cases of landlocked countries located in the richest 10% of the world (e.g., Luxembourg, Switzerland and Austria) have been cited.

The channel of transmission between the landlockedness and the economic dynamics of the countries focus on the negative relationship that exists in an expected (average) context between the restriction of access to the sea and the institutional quality; likewise, the reverse dynamic relationship that exist between the deterioration of institutional quality and economic growth.

A relevant factor is the response of institutional quality to the shock of a landlocked country and its structural relations with investment, economic growth, the external sector and the level of social welfare, which counteracts the adverse impacts and allows us to discern and explain why some implications are negative and others have positive effects on the economic dynamics of countries.

Finally, a non-attempted act was originally reflected in the relevance of production cost innovations (marginal costs) in the risk premium as the source of greater variability.

In summary, as a central element for policy implications, the conditioning of institutional quality is enhanced to counteract the negative impact of being landlocked. In previous research, Acemoglu *et al.* (2001) found that institutions accounted for 28% of economic growth, similar to the 20% estimate found for the model addressed.

4. LIMITATIONS OF RESEARCH AND AGENDA FOR FUTURE WORK

As a result of the importance linked to the role of institutions in the dynamics of landlocked countries (without access to the sea), new challenges are posed in the measurement of institutionalism, which is an agenda for future work: hostile neighbors, colonial heritage, economic freedom, democracy, political stability and property rights (Narayan *et al.*, 2011; Peev and Mueller, 2012; Aisen and Veiga, 2013; Sievers and Urbatsch, 2018).

Similarly, a modeling with Bayesian estimates can be contemplated in the calibration of the parameters of the model in order to refine the findings with a more disaggregated specification on the part of the institutional indicators.

Another research potential, could be the interaction of institutional role and the double curse in terms of landlocked and dependence on natural resources (*natural resource curse*) (Hance, 1975; Mehlum *et al.*, 2006; Arvis *et al.*, 2010; Sharma and Davaakhuu, 2015).

In the same vein, in future research, important counterfactual or comparative cases can be considered through old questions with new angles*: what explains the difference between developed and at the same time landlocked countries (e.g., Luxembourg, Switzerland and Austria) against countries that are at the last percentile of income*? The main challenge would be focused on economic structuring and assumptions in the establishment of modeling.

Assuming a level of exogeneity about the role of institutions in the economic dynamics of countries, with or without access to the sea, *what determines or explains the behavior of the institutions? How can the response mechanism in the institutions be changed?* These are open questions for future research work, with the consideration of a critical assumption of considering institutions as endogenous rather than exogenous. For this reason, some important premises are highlighted: the role of colonization (legal origin) in institutions, determining historical factors and the impact of economic geography (La Porta *et al.*, 1999; Acemoglu *et al.*, 2001; Auer, 2013).

Finally, it is possible to include the spatial effect and institutional quality of neighboring countries, as well as charges and impositions for transit infrastructure, political relations in non-cooperative playing conditions (tariffs and administrative procedures), between countries with maritime coasts and landlocked countries (Faye *et al.*, 2004; Bosker and Garretsen, 2009; Normizan and Yasunori, 2014).

5. CONCLUSIONS

This study addressed two research questions: the first one is linked to the *shocks of being a landlocked country*, and the second question addressed was a mechanism to mitigate the effect and their respective quantification.

The general premise of permanent negative effects on *Non-Maritime Goods* (those that characterize a Mediterranean country) was raised, as well as the premise on the role of institutions to counteract such an adverse effect.

To this end, a *2x2x2 model* was adapted, whose approach is constituted in an alternative model, not observed or noticed in the existing literature, as a non-conventional approach in comparison with other previous methodologies (e.g., standard regressions), which provides additive inferences and estimates to the set of existing research with implications for the application of public policies from an institutional explanation.

In this sense, an economy was considered to possess two types of consumers: *maritime families and non-maritime families*; two types of goods and firms: *maritime products* (fishing and maritime industry) and *non-maritime products* (traditional products of a landlocked country); *two factors of production*: physical capital stock and labor (*maritime and non-maritime, respectively*).

The model was calibrated for a specific case: the Bolivian economy (example of a country with maritime landlocked) and in observational equivalence with similar countries in conditions of access to the sea for impact assessment purposes.

The results revealed the relative importance of aggregate production from the *shocks of the landlocked country* (about 80%) and the institutional innovations (20% remaining) using a dynamic approach.

There was evidence of the negative effect of the permanent *shock* of the landlocked country on *Non-Maritime goods or production* (-2% annual), similar to the impact on *Non-maritime consumption and social welfare*; *Non-maritime aggregate investment* (-7%).

By introducing structural response changes (parameters) in the relationship including: a) landlocked-institutional quality; b) institutional quality-economic growth; c) landlocked-trade balance, the *negative shock* of a landlocked country would be reduced by 68%. Institutional innovations would change from negative effects to positive impacts, permanently, on the country's economic dynamics in a context of landlocked, which highlights the important role played by the institution in the implementation of public policies as a mitigating action.

The structural challenge means changing the empirical evidence found: where the condition of being a landlocked country is related to institutions with lower institutional quality (measured by an index) and having a negative impact on the level of economic activity on a permanent basis. However, mitigating or reversing the condition of being a landlocked country would imply a reduction in the negative impact on non-maritime goods.

Finally, new questions have been presented for future research aimed at explaining the factors that determine the behavior of institutional quality as a problem of endogeneity and the inclusion of the spatial effect in the vicinity of countries.

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APPENDICES

APPENDIX 1: DSGE MODEL 2X2X2

A1. MARITIME CONSUMERS, NON-MARITIME AND SOCIAL WELFARE

By virtue of the general characterization and assumptions of the model, as previously stated, the modeling of a small and open economy is divided into two types of representative households: maritime (with access to the sea) and Non-maritime (without access to the sea, respectively), is considered(C_t^M, C_t^{NM}).

For each type of representative consumer, the central objective is to maximize their function of intertemporal utility when making decisions in consumption(C_t^i), investment and leisure$(1 - L_t^i)$. In the case of savings-investment, two alternatives were presented: physical investment (I_t^i)(tangible assets) and government bonds (B_t) (assets with intrinsic value).

$$\max E_t \sum_{t=0}^{\infty} \beta^t S_t^{c,i} \left[\frac{C_t^{i\,1-\sigma}}{1-\sigma} - \frac{L_t^{i\,1+\psi}}{1+\psi} + \frac{\nu}{1-\sigma_q} \left(\frac{M_{t+s}^d}{P_{t+s}^i} \right)^{1-\sigma_q} \right] \qquad (A1)$$

Where, $0 < \beta < 1$

Where: β is a subjective parameter of discount; $E_t$is the expectations operator; σ corresponds to the risk aversion parameter; ν and$\psi$are utility weights associated with the work and the maintenance of actual balances respectively; M_t^dindicates nominal monetary balance andP_t^iindicates the prices of final goods for maritime and non-maritime products, respectively.

In (1) exists disturbances to intertemporal consumption ($S_t^{c,i}$), standardized to a unit value, in addition to the following budgetary restriction:

$$P_t^i(1+\tau_c)\left(C_t^i + I_t^i\right) + B_{t+1}/R_t^b = W_t^i L_t^i + R_t^i K_t^i(1-\tau_k) + B_t \qquad (A2)$$

Where for each type of good$i$, W_t^i corresponds to the nominal salary; B_t are the nominal bonds;$R_t^b$is the nominal rate; $R_t$is the average return of the physical capital (K_t^i); $\tau_k$corresponds to the profit tax.

Solving the optimization problem of A1 subject to A2, there are first order solutions$C_t^i, L_t^i, M_t^d$and Euler's equations.

(B_{t+1}, K_{t+1}^i):

$$\left(C_t^{i\,\sigma} L_t^{i\,\psi}\right)(1+\tau_c) = W_t^i/P_t^i \qquad (A3)$$

$$L_t^{i\,\psi} + \lambda_t{}^i W_t^i = 0 \qquad (A4)$$

$$\lambda_t{}^i \mathrm{P}_t^i = v\left(\frac{M_t^d}{\mathrm{p}_t^i}\right)^{\sigma_q} \quad \text{(A5)}$$

$$\frac{\mathrm{S}_t^{c,i}\mathrm{C}_t^{i\,-\sigma}}{\mathrm{p}_t^i} = \mathrm{R}_t^b \beta E_t \frac{\mathrm{S}_{t+1}^{c,i}\mathrm{C}_{t+1}^{i\,-\sigma}}{\mathrm{p}_{t+1}^i} = \mathrm{R}_t^b \quad \text{(A6)}$$

$$\mathrm{S}_t^{c,i}\mathrm{C}_t^{i\,-\sigma} = \beta \frac{\mathrm{S}_{t+1}^{c,i}\mathrm{C}_t^{i\,-\sigma}}{\mathrm{p}_{t+1}^i(1+\tau_c)}\left[(1-\delta)\mathrm{P}_{t+1}^i(1+\tau_c) + \mathrm{R}_t(1-\tau_k)\right] \quad \text{(A7)}$$

Where $\lambda_t{}^i$ corresponds to the Langrangian mechanism of the budgetary restriction in time t of each good.

Given the previous intertemporal optimization decisions A3, A4, A5, A6, and A7, families seek to reach the maximum level of social welfare (BS_t) according to their consumption and work decisions; since there is greater welfare at higher levels of consumption (level of satisfaction) and greater leisure time (lack of autonomy of the work factor);

$$BS_t = \left(C_t{}^{1-\sigma} - L_t{}^{1+\psi}\right) \quad \text{(A8)}$$

In 8, the budgetary constraint of non-maritime households is the trade-off between consumption and leisure: income is needed to be able to consume goods and services. For A9 and A10, an aggregation is made as follows in aggregate private consumption (C_t) and work(L_t), respectively.

$$\mathrm{C_t} = \int_0^1 C_{t,h}\,dh = \vartheta_0 \mathrm{C_{t,nm}} + (1-\vartheta_0)\mathrm{C_{t,m}} \quad \text{(A9)}$$

$$\mathrm{L_t} = \int_0^1 L_{t,h}\,dh = \vartheta'_0 \mathrm{L}_t^M + (1-\vartheta'_0)\mathrm{L}_t^{NM} \quad \text{(A10)}$$

Whereϑ_0 y ϑ'_0 represent the participation of each type of consumers, participation of each type of consumers and work, respectively.

A2. MARITIME AND NON-MARITIME FIRMS

Intermediate Goods Producing Firms

The economy's aggregate production depends on the level of intermediate goods production and a substitution elasticity for intermediate goods:

$$\mathrm{y_t} = \left(\int_0^1 \mathrm{y_{j,t}}^{\frac{\varphi-1}{\varphi}}\,\mathrm{dj}\right)^{\frac{\varphi}{\varphi-1}} \quad \text{(A11)}$$

Whereφ is the elasticity of substitution between intermediate goods. It also symbolizes the *mark-up* of prices. Consequently, it is assumed that the price level of the economy depends on the price sensitivity of intermediate goods:

$$P_t = \left(\int_0^1 P_{j,t}^{\frac{\varphi-1}{\varphi}} dj\right)^{\frac{\varphi}{\varphi-1}} \quad (A12)$$

Final goods producing firms

For the level of aggregate production, a set of representative firms being of two types is assumed and it operates by a Cobb-Douglas-type production function with the productive factors, capital and labor, respectively.

Similarly, two final goods sectors$\{i = 1,2\}$were obtained: maritime companies (fishing and maritime industry) and non-maritime companies (the rest, production is characteristic of the cloistered economy):

$$Y_t = \int_0^1 Y_{t,j} dj = \vartheta_1 Y_{t,nm} + (1 - \vartheta_1) Y_{t,m} \quad (A13)$$

Where:

$$Y_t^m = A_t^m K_t^{m\alpha_m} L_t^{m1-\alpha_m} \quad (A14)$$

$$Y_t^{nm} = A_t^{nm} K_t^{nm\alpha_{nm}} L_t^{nm1-\alpha_{nm}} \quad (A15)$$

In A14 and A15, α_m y α_{nm}represent respectively the share of the capital in the product; $A_{t,m}yA_{t,nm}$, correspond to maritime and non-maritime productivity, which follows the notion by A16 and A17:

$$\log A_t = (1 - \rho_A)\log A_{ss} + \rho_A \log A_{t-1} + \epsilon_{A,t} \quad (A16)$$

$$\log A_{t,nm} = (1 - \rho_{A,nm})\log A_{ss,nm} + \rho_{A,nm} \log A_{t-1,nm} + \epsilon_{Anm,t} \quad (A17)$$

$\rho_A y \rho_{A,nm}$ correspond to the autoregressive component and$\epsilon_{A,t}$, $\epsilon_{Anm,t}$represent exogenous shocks of maritime and non-maritime productivity, respectively.

In A18 and A19, the future dynamics of the capital stock, moves by:

$$k_{i,t+1} = i_{i,t} + (1 + \delta)k_{i,t} \quad (A18)$$

$$k_{i,t} = \int_0^1 k_{i,j} dj = \vartheta_2 k_{t,nm} + (1 - \vartheta_2) k_{t,m} \quad (A19)$$

Where the investment is composed of its private$(\varrho^{privada})$and public proportion, respectively(ϱ^{gob}) in A20 and A21 respectively:

$$i_t = \varrho^{privada} + \varrho^{gob} \quad (A20)$$

$$i_{i,t} = \int_0^1 i_{i,j} dj = \vartheta_3 i_{t,nm} + (1 - \vartheta_3) i_{t,m} \quad (A21)$$

They are additional A22 subject to budgetary restriction:

$$W_{i,t} * L_{i,t} + R_{i,t}K_{i,t} \quad \text{(A22)}$$

The optimization problem focuses on minimizing the budgetary costs of production A22 subject to the production function as A14 and A15.

Using the Lagrangian mechanism $(\mathcal{L})$:

$$\mathcal{L} = W_{i,t} * L_{i,t} + R_{i,t}K_{i,t} - mc_i\left(A_{i,t}K_{i,t}^{\alpha}L_{i,t}^{1-\alpha}\right) \quad \text{(A23)}$$

In A23, you have the first order conditions: $\frac{\partial \mathcal{L}}{\partial L_{i,t}}; \frac{\partial \mathcal{L}}{\partial K_{i,t}}$ for A24 and A25:

$$W_{i,t} = mc_i(1-\alpha_i)Y_{i,t}/L_{i,t} \quad \text{(A24)}$$

$$R_{i,t} = mc_i\alpha_i Y_{i,t}/K_{i,t} \quad \text{(A25)}$$

Similarly, there are processes of aggregations for wages and interest rate in A26 and A27:

$$W_{i,t} = \int_0^1 W_{i,j}dj = \vartheta_4 W_{t,nm} + (1-\vartheta_4)W_{t,m} \quad \text{(A26)}$$

$$R_{i,t} = \int_0^1 R_{i,j}dj = \vartheta_5 R_{t,nm} + (1-\vartheta_5)R_{t,m} \quad \text{(A27)}$$

Alternatively, an optimization strategy consists of maximizing your profits by choosing the price of the good *I in A28*:

$$max_{Pi,t}P_{i,t}Y_{i,t} - W_{i,t} * L_{i,t} - R_{i,t}K_{i,t} \quad \text{(A28)}$$

Whereby assuming A11 y A12:

$$mc_{i,t} = \left(\frac{\varphi-1}{\varphi}\right)P_{i,t} \quad \text{(A29)}$$

Replacing A29 in A24 and A25, we got A30 and A31:

$$W_t/P_t^{\,i} = \left(\frac{\varphi-1}{\varphi}\right)(1-\alpha)Y_t/L_t^{\,i} \quad \text{(A30)}$$

$$R_t/P_t^{\,i} = \left(\frac{\varphi-1}{\varphi}\right)\alpha Y_t/K_t^{\,i} \quad \text{(A31)}$$

Price fixing according to Calvo (1983)

The Calvo (1983) holds that the current price level is a composition between rigidity, in probabilistic terms θ, with the possibility of maintaining the same price from the previous period and the remaining probability (1-θ) with transition to an optimal price:

$$P_t^{\,i} = \left[\theta P_{t-1}^{1-\varphi} + (1-\theta)P_t^{*1-\varphi}\right]^{\frac{1}{1-\varphi}^{\,i}} \quad \text{(A32)}$$

From A32, there is need to specify a Phillips Curve function in its Neo-Keynesian version, from A33 to A35:

$$\pi_t{}^i = \gamma\pi_{t-1}{}^i + \beta\pi_{t+1}{}^i + \frac{(1-\theta)(1-\theta\beta)}{\theta} mc_t{}^i \; \forall\, i = m, nm \qquad \text{(A33)}$$

$$\pi_{i,t} = \int_0^1 \pi_{i,t}di \; = \vartheta_6\pi_{t,\text{dom}} + \; (1-\vartheta_6)\pi_{t,\text{ext}} \qquad \text{(A34)}$$

$$\pi_{\text{dom},t} = \int_0^1 \pi_{j,t}dj \; = \vartheta_7\pi_{t,\text{m}} + \; (1-\vartheta_7)\pi_{t,\text{nm}} \qquad \text{(A35)}$$

Defining marginal costsmc_t, is represented by A36 and A37:

$$mc_t{}^i = \left[\frac{1}{A_t}(R_t^{\alpha} * W_t^{1-\alpha})\right]^i \qquad \text{(A36)}$$

$$mc_t = \int_0^1 mc_{j,t}dj \; = \vartheta_8 mc_{t,\text{m}} + \; (1-\vartheta_8)mc_{t,\text{nm}} \qquad \text{(A37)}$$

A3. GOVERNMENT

In government, the tax authority collects taxes, has oil revenues, conducts current public expenditures and government fixed investment.

The government's current consumption expenditure is considered as a factor dependent on its own innovations by virtue of the absence of a fiscal rule.

The expression A38 incorporates the negative effect on the tax collection of imports $(\Theta_{TB} < 1)$in the condition of a country with maritime enclosure$(EM_t = 1)$.

Tax collection is endogenous to the following behavior from A38 to A41 respectively with taxes, fiscal balance, oil revenues and public spending:

$$Tax_t = P_t(\tau_c)(C_t + Ifp_t) + \tau_k R_t K_t + e_t\tau_m M_t{}^{**}(1 + \Theta_{TB} * EM_t) \qquad \text{(A38)}$$

$$BALf_t = Tax_t + Oil_t - P_t * (G_t + Ifg_t) \qquad \text{(A39)}$$

$$\log \text{Oil}_t = (1-\rho_{\text{oil}})\log(\overline{\text{OIL}}) + \rho_{oil}\log \text{Oil}_{t-1} + \epsilon_{\text{Oil},t} \qquad \text{(A40)}$$

$$\log \text{G}_t = (1-\rho_{\text{G}})\log(\overline{\text{G}}) + \rho_G \log \text{G}_{t-1} + \epsilon_{\text{G},t} \qquad \text{(A41)}$$

Where the values represent their respective steady states: $\overline{\text{M}}, \overline{\text{OIL}}, \overline{\text{G}}\; \text{y} \overline{\text{IFG}}$

The dynamics of public debt is a function of previous variables express in A42:

$$\frac{B_{t+1}}{R_{t+1}^b} - B_t = P_t(G_t + Ifg_t) - BALf_t - Tax_t \qquad \text{(A42)}$$

A4. MONETARY POLITICS

The central bank is considered as being guided by an action of nominal and real growth in money balances, where A43 and A44 are equal money demand and money supply growth:

$$m_{t+1}^{r} = \frac{g_{m,t}}{\pi_{t+1}} m_t^r \quad \text{(A43)}$$

$$m_t^d = m_t^r \quad \text{(A44)}$$

Likewise, the discretion of the Central Bank in the interest rate responds to the product gap and it is a function of inflation (similar to a Taylor scheme), and innovations in monetary growth (A45 and A46) with feedback of oil shocks:

$$R_t^B = \gamma_a(y_t - y^*) + \gamma_b(\pi_t - \pi^*) + \varepsilon_{sm} \quad \text{(A45)}$$

$$\log g_{m,t} = (1 - \rho_{pm}) \log(\overline{g_{m,t}}) + \rho_{pm} \log g_{m,t-1} + \vartheta \epsilon_{Oil,t} + \epsilon_{pm,t} \quad \text{(A46)}$$

A5. EXTERNAL SECTOR

The objective of this section is to link basic relations between trade balance, sensitivity to the real exchange rate, different accounting equivalences of external savings or current account deficit and their relation to external debt, risk premium, interest rates and the level of economic activity.

Net exports are understood as the difference between exports and imports, also called the trade balance (tb_t), with the consideration of an elasticity (η) to the change in the real exchange rate (ΔS_t^{tcr}), whose estimate corresponds to the Marshall-Lerner coefficient.

$$(1 + \theta_{TB} * EM_t) * tb_t = \eta * [S_t^{tcr} - S_{t-1}^{tcr}] \quad \text{(A47)}$$

In the expressions A47 and A49, the negative effect on the trade balance of imports is incorporated $(\theta_{TB} < 1)$in the condition of a landlocked country$(EM_t = 1)$.

Similarly, within the external sector, there is the current account balance(ca_t), as the accounting difference between domestic savings $(S_{d,t})$ and aggregate investment: private $(ifp_t)$and public $(Ifg_t)$is potentialised by the savings innovations or private investment(S_t^{ipr}):

$$ca_t = S_{d,t} - ifp_t * S_t^{ipr} - Ifg_t \quad \text{(A48)}$$

The accounting definition of the current account is on the side of net exports, factor services (f_t) and remittances(r_e):

$$(1 + \Theta_{TB} * EM_t) * tb_t + f_t + r_e = \mathrm{ca}_t \quad \text{(A49)}$$

The other equivalence of the expression A48 and A49 is on the side of domestic savings: composed of household savings, external savings and government savings in A50:

$$\mathrm{S}_{d,t} = \mathrm{s}_y * \mathrm{y}_t + \mathrm{E}_r * \mathrm{cab}_t + \mathrm{Ifg}_t \quad \text{(A50)}$$

Where s_y and E_r represent the marginal propensity to save and a numerary of the nominal exchange rate, respectively.

Effects are incorporated (ψ') on the risk premium proportional to the level of external indebtedness (de_t) as a proportion of GDP, which is reflected in the local interest rate (R_t^b) in A51 and A52 respectively:

$$riskpremium_t = \psi' de_t \quad \text{(A51)}$$

$$R_t^b = r_{world} + riskpremium_t \quad \text{(A52)}$$

Likewise, the economy can acquire external debt (de_t) to finance its consumption and investment not reflected by income (production), equivalent to a macro-added budgetary restriction (A53):

$$de_t = (1 + r_{world,t-1}) de_{t-1} + P_t(-y_t + c_t + i_t + g_t) + \frac{\xi}{2}(k_{t+1} - k_t)^2 \quad \text{(A53)}$$

Where ξ represents the adjustment cost in the growth of the capital stock (K_t).

It incorporates the relationship with the rest of the world, through: the trade balance and the current account deficit (A54):

$$tb_t * (1 + \Theta_{TB} * EM_t) = 1 - \frac{c_t + i_t + g_t}{y_t} \quad \text{(A54)}$$

The expression (54) is equivalent to A55:

$$y_t = c_t + g_t + ifp_t + ifg_t + tb_t * (1 + \Theta_{TB} * EM_t) \quad \text{(A55)}$$

On the other hand, the current account balance is linked to the level of external debt (de_t) and the level of economic activity (y_t) in A56:

$$ca_t = \frac{1}{y_t} * (de_t) \quad \text{(A56)}$$

In this section, other AR disturbances are assumed: an exchange-rate self-regulatory shock, one in private investment-save, one of marginal costs or production costs and another of inflationary shock, from A57 to A60:

$$S_t^{tcr} = \rho_{tcr} S_{t-1}^{tcr} + \epsilon_{tcr} \quad \text{(A57)}$$

$$S_t^{ipr} = \rho_{ipr} S_{t-1}^{ipr} + \epsilon_{ipr} \quad \text{(A58)}$$

$$mc_t = \rho_{mc} mc_{t-1} + \epsilon_{mc} \quad \text{(A59)}$$

$$\pi_t = \rho_{\pi} \pi_{t-1} + \epsilon_{\pi} \quad \text{(A60)}$$

A6. ROLE OF THE LANDLOCKED AND INSTITUTIONS

Previously, it has been pointed out the expected negative effect of a landlocked country on the trade balance and tax collections directly for taxes on imports, similar to $(\theta_{TB} < 0)$.

On the other hand, the general evidence of being a landlocked country$\{1 = \text{with no access to the sea},\ 0\ \textit{with access}\}$have been widely addressed and estimated, with a predominantly negative effect on economic growth $(\theta_{YL} < 0)$, that negatively affects the quality of the institutions $(\theta_{CI} < 0)$,as well as negatively affects a recursive virtuous circle. Institutional quality is measured by an index with the maximum value of one (the higher the better).

The estimation of these parameters corresponds to average effects, subject to variable control and the use of econometric instruments to avoid endogeneity problems or simultaneous conditions of explanation (Dollar and Kraay, 2003; Head *et al.*, 2010; Paudel, 2014; Carmignani, 2015) where institutional quality is assumed to be a component of exogenous innovation, in the expressions from A61 to A63:

$$\left(\frac{Y}{l}\right)_t = \theta_{CI} * \theta_{Yl} * EM_t \quad \text{(A61)}$$

$$CI_t = \rho_{CI} * CI_{t-1} + \epsilon_{CI} \quad \text{(A62)}$$

$$EM_t = \rho_{EM} * EM_{t-1} + \epsilon_{EM} \quad \text{(A63)}$$

Appendix-2. Model Calibration

Parameters	**Symbol**	**a) Maritime Economy (Observational equivalent) COL, ECU, PER y CHI**	**b) Non-maritime Economy (Example with Bolivia)**	**c) Structural challenge (Mitigation of the landlocked)**
Capital Participation In Product	α	0.33	0.39	0.39
Parameter sub□ect to discount	β	0.98	0.98	0.98
Capital depreciation rate	δ	0.04	0.05	0.05
Frisch Reverse Elasticity	υ	2.17	2.17	2.17
Money-utility weighting	σ_g	1.32	1.32	1.32
Reverse of the Mark up	φ	6.00	6.00	6.00
Risk aversion	σ	2.00	2.00	2.00
Disutili□y of w□r□	ψ	1.50	1.50	1.50
Probability Price Rigidity	θ	0.54	0.39	0.39
Marginal Savings Ratio	s_y	0.07	0.07	0.07
AR term (maritime and non-maritime productivity)	ρ_a	0.50	0.50	0.50
AR Public spending term	ρ_g	0.50	0.50	0.50
AR Private saving term	ρ_{aho}	0.50	0.50	0.50
AR Interest Rate	ρ_m	0.50	0.50	0.50
AR Real Exchange rate term	ρ_{tcr}	0.50	0.50	0.50
AR Oil prices term	ρ_{oil}	0.50	0.50	0.50
AR Cost of production term	ρ_{mc}	0.50	0.50	0.50
AR inflation rate term	ρ_π	0.50	0.50	0.50
AR Quality institutional □erm	ρ_{CI}	0□50	0.50	0.50
AR Landlocked condition term	ρ_{EM}	0.50	0.50	0.50
Marshall-Lerner Coefficient	η	0.48	0.48	0.48
Sensitivity Yt Gap - Interest Rate	γ_a	0.50	0.50	0.50
Inflation sensibility to Interest rate	γ_b	1.50	1.50	1.50
Public Spending – Risk □remia □oe□.	ψ'	0.001	0.001	0.001
Capital adjustment cost	ξ	0.20	0.20	0.20
Relative participation of the Non-Maritime sector in the total aggregate (C, I, K, Y, W, R, π, mc)	ϑ	0.70	0.70	0.70
Effect on Growth of being a Landlocked country	θ_{Yl}	0.00	-0.00698	+0.006□8
Effect of being landlocked country on trade balance	θ_{TB}	0.00	-0.51	+0.51
Effect of being landlocked country on quantity institutional rate	θ_{CI}	0.00	-0.073	+0.073

Appendix 3. Steady state.

Through the calibrated parameters of the model, we find the steady state $(SS - SteadyState)$ of the main theoretical variables of the economy$(i = 1, 2, maritime\ and\ non - maritime)$, recursively, considering the world interest rate, the working hours of families (1/3) and external indebtedness as exogenous assumptions, from A64 to A79:

$$r_{world_{ss}} = \overline{r_{world}} \quad \text{(A64)}$$

$$h_{ss}{}^{i} = 1/3 \quad \text{(A65)}$$

$$g_{ss}{}^{i} = \overline{g_{bar}}^{i} \quad \text{(A66)}$$

$$mc_{ss}{}^{i} = \frac{\varepsilon - 1^{i}}{\varepsilon} \quad \text{(A67)}$$

$$de_{ss}{}^{i} = \overline{de_{bar}}^{i} \quad \text{(A68)}$$

$$g_{m,ss}{}^{i} = \overline{g_{m,trim}}^{i} \quad \text{(A69)}$$

$$\pi_{m,ss}{}^{i} = \overline{\pi_{trim}}^{i} \quad \text{(A70)}$$

$$R_{ss}{}^{i} = [(1/\beta) - (1 - \delta)] \quad \text{(A71)}$$

$$k_{ss}{}^{i} = h_{ss}{}^{i} * \left[\frac{R_{ss}{}^{i}}{(\alpha * mc_{ss}{}^{i})^{\frac{1}{\alpha - 1}}}\right] \quad \text{(A72)}$$

$$y_{ss}{}^{i} = k_{ss}{}^{i\alpha} h_{ss}{}^{i1-\alpha} \quad \text{(A73)}$$

$$i_{ss}{}^{i} = \delta k_{ss}{}^{i} \quad \text{(A74)}$$

$$i_{priv_{ss}}{}^{i} = \varrho^{priv} i_{ss}{}^{u} \quad \text{(A75)}$$

$$i_{gob_{ss}}{}^{i} = \varrho^{gob} i_{ss}{}^{i} \quad \text{(A76)}$$

$$c_{ss}{}^{i} = \left(y_{ss} - i_{priv_{ss}} - i_{gob_{ss}} - de_{ss} * r_{world_{ss}} - g_{ss}\right) \quad \text{(A77)}$$

$$tb_{ss}{}^{i} = \left(y_{ss - i_{priv_{ss}} - i_{gob_{ss}} - c_{ss} - g_{ss}}\right)^{i} \quad \text{(A78)}$$

$$w_{ss}{}^{i} = (1 - \alpha) * mc_{ss}{}^{i} * \frac{y_{ss}{}^{i}}{h_{ss}} \quad \text{(A79)}$$

Appendix-4. Analysis of Variance Decomposition (in Percentage Composition).

Period 1	Types of Shocks								
	Landlockness	Institutional	Non-maritime productivity	Maritime productivity	Monetary policy (interest rate)	Monetary policy (growth money)	Priv. Sav-Invest.	Cost of production	Inflationary inertia
Production	79	21	0	0	0	0	0	0	0
Maritime Product	69	18	0	13	0	0	0	0	0
Non-maritime Product	0	0	0	100	0	0	0	0	0
Consumption	40	11	42	8	0	0	0	0	0
Non-maritime Consumption	40	11	42	8	0	0	0	0	0
Bonds	45	12	0	0	43	0	0	0	0
Public debt	11	1	4	3	1	0	0	79	0
Non-maritime investment	26	7	14	2	3	0	0	48	0
Investment	40	10	0	0	0	0	50	0	0
Fiscal Balance	45	12	0	0	43	0	0	0	0
Real monetary balance	0	0	0	0	0	33	0	33	33
Net exports	50	50	0	0	0	0	0	0	0
Current account	79	21	0	0	0	0	0	0	0
Inflation	0	0	0	0	0	0	0	0	100
Social Welfare	40	11	42	8	0	0	0	0	0
Institutional quality	0	100	0	0	0	0	0	0	0
Condition of being Landlocked	100	0	0	0	0	0	0	0	0
Risk premium	11	1	4	3	1	0	0	79	0

Period 5	Types of Shocks								
	Landlockness	Institutional	Non-maritime productivity	Maritime productivity	Monetary policy (interest rate)	Monetary policy (growth money)	Priv. Sav-Invest.	Cost of production	Inflationary inertia
Production	79	21	0	0	0	0	0	0	0
Maritime Product	7	2	3	0	8	0	0	80	0
Non-maritime Product	8	2	3	0	8	0	0	79	0
Consumption	29	8	1	0	27	0	0	35	0
Non-maritime Consumption	29	8	1	0	27	0	0	35	0
Bonds	44	12	0	0	43	0	0	1	0
Public debt	21	7	1	0	26	0	0	7	37
Non-maritime investment	33	8	1	0	30	0	0	28	0
Investment	40	10	0	0	0	0	50	0	0
Fiscal Balance	44	12	0	0	43	0	0	1	0

Real monetary balance	3	1	1	0	4	16	0	55	21
Net exports	50	50	0	0	0	0	0	0	0
Current account	79	21	0	0	0	0	0	0	0
Inflation	0	0	0	0	0	0	0	0	100
Social Welfare	29	8	1	0	27	0	0	35	0
Institutional quality	0	100	0	0	0	0	0	0	0
Condition of being Landlocked	100	0	0	0	0	0	0	0	0
Risk premium	10	1	4	3	1	0	0	69	12

… CONTINUATION OF APPENDIX 4…

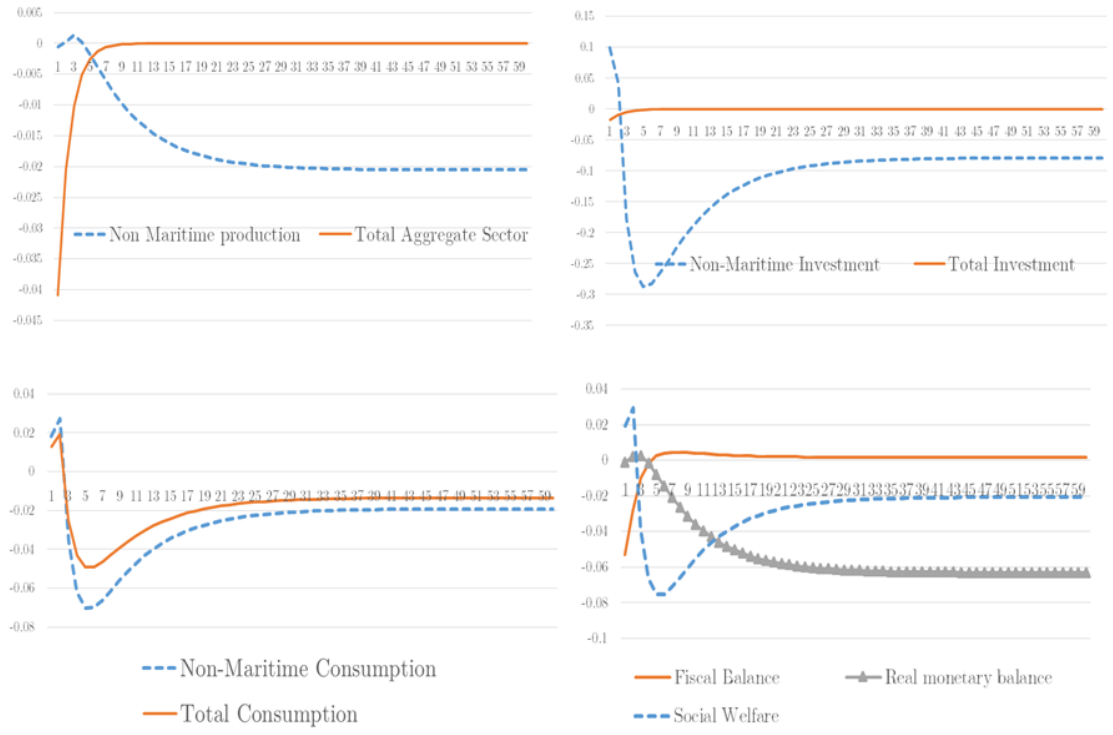
Period 10	**Types of Shocks**								
	Landlockness	**Institutional**	**Non-maritime productivity**	**Maritime productivity**	**Monetary policy (interest rate)**	**Monetary policy (growth money)**	**Priv. Sav-Invest.**	**Cost of production**	**Inflationary inertia**
Production	79	21	0	0	0	0	0	0	0
Maritime Product	38	10	0	0	39	0	0	13	0
Non-maritime Product	38	10	0	0	39	0	0	13	0
Consumption	37	10	1	0	35	0	0	18	0
Non-maritime Consumption	37	10	1	0	35	0	0	18	0
Bonds	44	12	0	0	43	0	0	1	0
Public debt	28	9	1	0	31	0	0	5	26
Non-maritime investment	39	10	0	0	36	0	0	14	0
Investment	40	10	0	0	0	0	50	0	0
Fiscal Balance	44	12	0	0	43	0	0	1	0
Real monetary balance	32	8	0	0	34	4	0	17	5
Net exports	50	50	0	0	0	0	0	0	0
Current account	79	21	0	0	0	0	0	0	0
Inflation	0	0	0	0	0	0	0	0	100
Social Welfare	37	10	1	0	35	0	0	18	0
Institutional quality	0	100	0	0	0	0	0	0	0
Condition of being Landlocked	100	0	0	0	0	0	0	0	0
Risk premium	10	1	4	3	1	0	0	68	13

… CONTINUATION OF APPENDIX 4…

Period 20	Types of Shocks								
	Landlockness	**Institutional**	**Non-maritime productivity**	**Maritime productivity**	**Monetary policy (interest rate)**	**Monetary policy (growth money)**	**Priv. Sav-Invest.**	**Cost of production**	**Inflationary inertia**
Production	79	21	0	0	0	0	0	0	0
Maritime Product	43	11	0	0	43	0	0	2	0
Non-maritime Product	43	11	0	0	43	0	0	2	0
Consumption	39	10	0	0	37	0	0	14	0
Non-maritime Consumption	39	10	0	0	37	0	0	14	0
Bonds	44	12	0	0	43	0	0	0	0
Public debt	33	9	0	0	35	0	0	4	19
Non-maritime investment	40	10	0	0	38	0	0	11	0
Investment	40	10	0	0	0	0	50	0	0
Fiscal Balance	44	12	0	0	43	0	0	1	0
Real monetary balance	42	11	0	0	42	1	0	3	1
Net exports	50	50	0	0	0	0	0	0	0
Current account	79	21	0	0	0	0	0	0	0
Inflation	0	0	0	0	0	0	0	0	100
Social Welfare	39	10	0	0	37	0	0	14	0
Institutional quality	0	100	0	0	0	0	0	0	0
Condition of being Landlocked	100	0	0	0	0	0	0	0	0
Risk premium	10	1	4	3	1	0	0	68	13

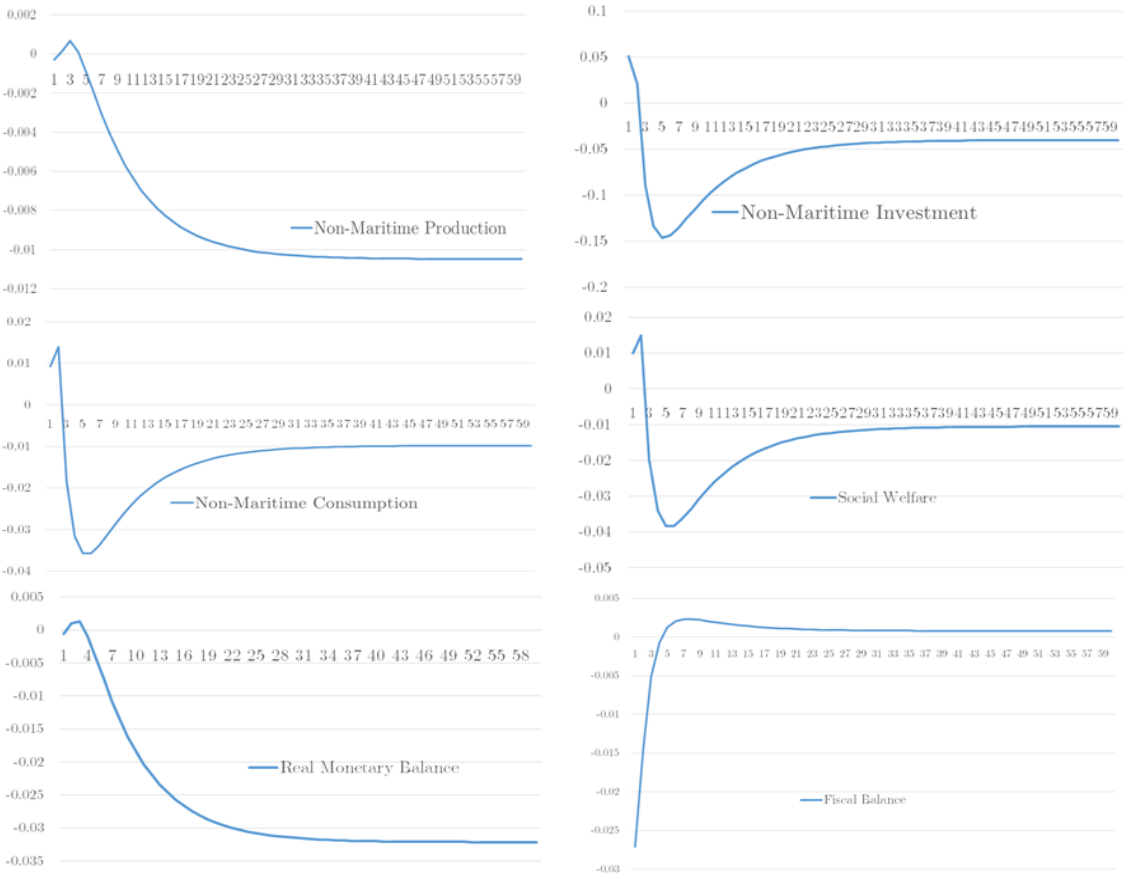
… CONTINUATION OF APPENDIX 4…

Appendix-5. Impulse-Response Functions

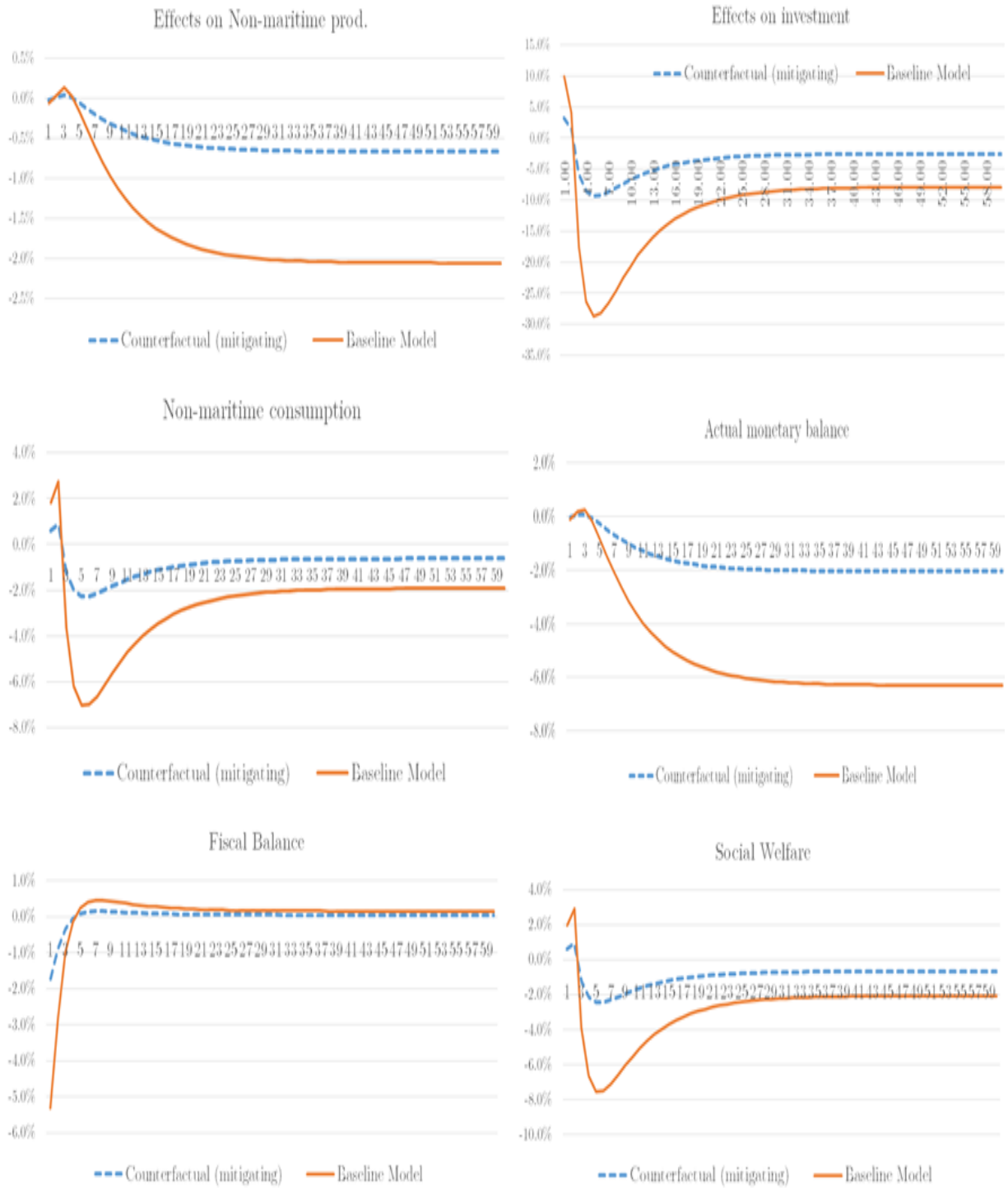


Appendix-5a. Effect of the shock of being landlocked in Bolivia (in number of periods (years) forward).

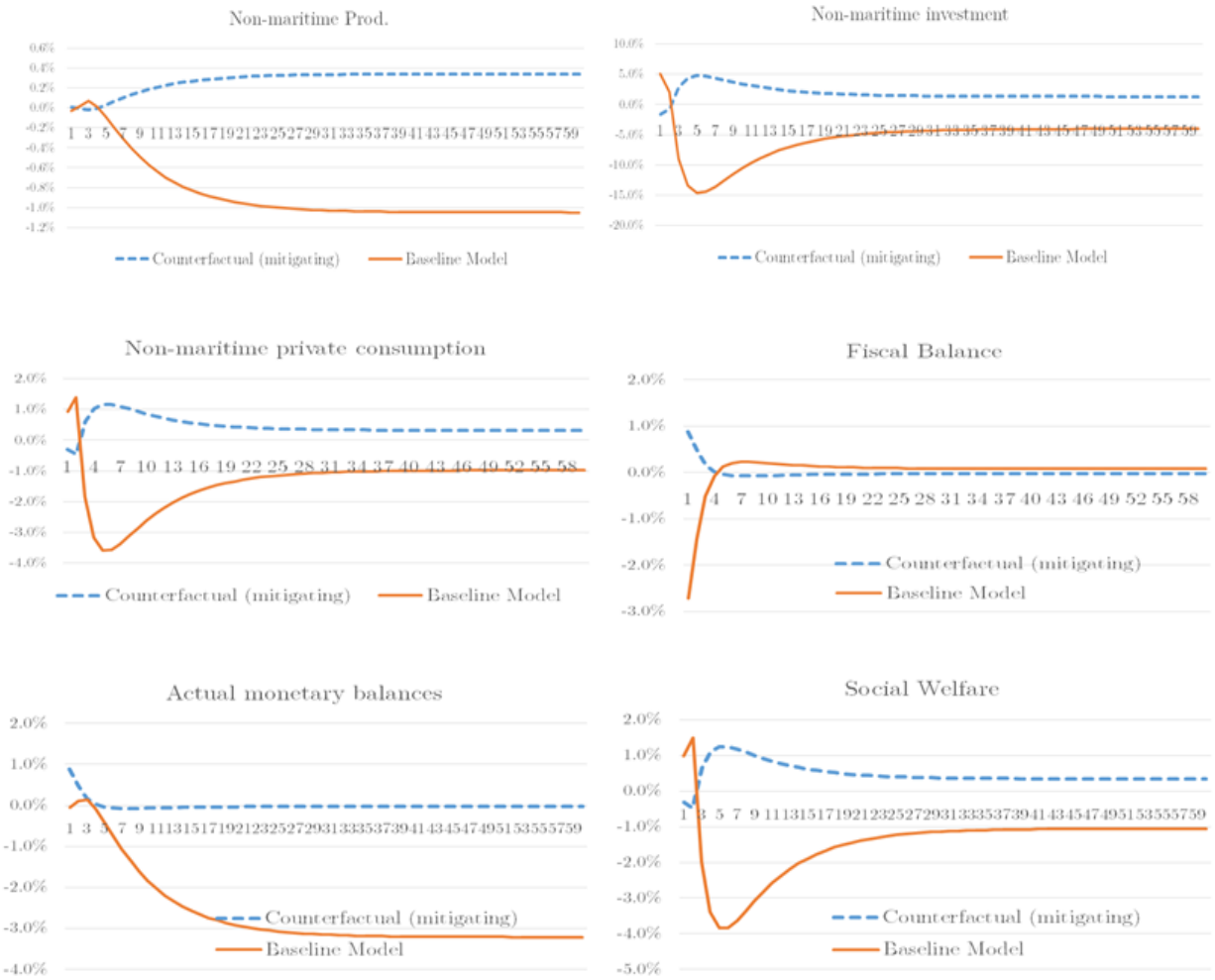
Source: Own estimations.



Appendix-5b. Effect of institutional innovation in the context of being a landlocked country (In Number of Periods (Years) Forward).



Appendix-5c. Structural challenge: Mitigation of the shock of being a landlocked country (in number of periods (years) forward).



Appendix-5d. Structural challenge: institutional challenge to counter the landlocked (in Number of Periods (Years) Forward).

Appendix-6. Used variables.

Variables	Estimations	Assumption
Variables in steady state	Derived from model calibration.	Own estimations of log-linear variables. Counterfactual economies: • Elosegui and Grosman (2016). • Bonaldi *et al.* (2011). • García-Cicco *et al.* (2015). • León (2016). • Cabezas (2016). • Osorio-Copete (2016).
C, I, G, Y^{NM}, Y^{M} and other macro variables.	Normalized in relation to the product (Y),	Comparable data observed from Penn World Table (1950 -2014).
CI	Institutional Quality Index	It's between 0 and 1, the higher the better.
Stochastic and individual shocks	2% increase	All shocks in the model are identical and persistent idiosyncratic disturbances, which monitor reactions to the same magnitude of variability.