Development Of The Compensatory Residual Effect (Cre) Concept For Evaluation Of The Induced Effects Of Launching A New Port On The Customs Activity Of Existing Ports In Cameroon

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Abstract
Background: As of March 2018, the newly created Kribi port has entered into competition with the existing Douala port in Cameroon. The purpose of this paper is to assess the induced effects generated by this new port on Douala Port custom's activities over the 2019-2021 three-year period.
Setting: Annual data spanning 2007-2018 was used.
Aims: This research develops the concept of compensatory residual effect in order to fix the matter of biases due to exogenous time-related factors, and apply it for the assessment of induced effects generated by the opening of the said new port.
Methods: The paper apply the double exponential smoothing method for estimating counterfactual values and then combining the with-without method with the said concept of compensatory residual effect.
Results: The commissioning of the Kribi Port has induced a transfer of customs performance from the Douala Port to Kribi Port estimated at 13,5, 92,4 and 174,7 billion FCFA of customs revenue in 2019, 2020 and 2021 respectively, representing 18%, 75% and 88% of Kribi Port's activities.
Conclusion: Based on these findings, the document recommends an in-depth diagnostic study of the determinants of the two ports' attractiveness, in order to improve port competitiveness with a view to optimizing economic performance at national level.
Contribution: The concept of compensatory residual effect, as developed in this paper, makes a significant contribution to the ex-post evaluation of port competitiveness. It can be applied to assessments studies within organizations such as banks, provided the assumptions made in this paper.
Keywords: Impact, Induced-effect, Compensatory Residual Effect, Double exponential smoothing, Competitive balance, Counterfactual value, biases, exogenous factors

I. Introduction

Impact evaluation studies are usually commissioned for several reasons. Some times to decide on the funding, to provide guidance to continue a program or whether the program should be replicated. At times to reassure donors of the effectiveness of their funding, and also to inform the public authorities, including the targets, of the changes caused by an intervention.

Aware of the important role of these studies in establishing causal links between an intervention and the results obtained, the fundamental problem lies in the choice of method and the process of dealing with biases that may be due to exogenous factors or to the selection of program beneficiaries.

There are generally two approaches to impact assessment: Experimental design that randomly assigns the intervention among eligible targets for treatment and quasi-experimental designs which is the most popular because of its flexibility in terms of cost and data availability. These latter approaches are used when it is difficult to use experimental approaches to set up target and control groups. In this case, we need to be rigorous in dealing with bias, by taking into account unobservable factors likely to bias the impact estimate. For example, the lack of knowledge on unobservable characteristics when using matching method can distort the understanding of the initial differences existing between the two tests and control groups and then forces to fix the nullity hypothesis of the said unobservable effects. Moreover, the occurrence of external factors during a program and the difficulty of controlling their effects on both groups when using the **Differences in Difference** method may affect the difference in trend between the two groups, especially when a longer period is required for the effects of the program to become apparent.

Most of quasi and non-experimental methods are useful for demonstrating the immediate impact of short-term programs, but the risk of bias arises when they are used to evaluate longer-term interventions.

Background of Kribi Port (KP)

The corner stone of the Kribi Deep Sea Port in Cameroon was laid on 8 October 2011. Its construction effectively started in 2012 and finally came to fruition in 2014 with the arrival of the first ships that year. Since the launch of commercial operations in 2018, the Kribi Port (KP) has the ambition to become a major port and logistics platform in the sub-region, given the size of its infrastructures. It is important to mention that the Kribi Port operates in close proximity to the Douala Port, located in the Wouri estuary on the coast, which was created in 1999 and whose first installations date back to 1881[1]. While the launch of commercial operations at the Port of Kribi was welcomed in view of its prospects for boosting trade and customs revenue, it has to be said that the customs offices at the Port of Douala (DP) were immediately alarmed, seeing the new port as an opportunity to divert their activities. Indeed, since 2020, the operational customs departments within the DP have regularly reported the decline in their customs clearance activities, as well as the difficulty of continuing to meet performance targets due to the relocation of some operators' customs clearance activities to the Port of Kribi. This study was initiated in light of these observations to assess the impact of the new port on customs activities at the Port of Douala, and to quantify the level of activity transfer.

In view of the major events in the 2019-2021 period that are likely to influence customs activities, including the outbreak of the COVID 19 pandemic and the changeover of the customs IT system, this paper presents a rigorous evaluation approach that takes into account exogenous factors to the program. It develops the concept of compensatory residual effect (CRE), which expresses the consideration of other events outside the program under evaluation that could affect impact indicators during the evaluation process. We then apply the said concept to assess the induced effects of the commissioning of the Kribi Port launched in 2018 on the customs activities of the Douala Port, which has existed for several decades.

Problem and objectives

The problem raised by this study is to develop an optimal valuation approach that takes into account events not foreseen by the program under evaluation that could affect outcomes in order to assess the impact generated by the commissioning of the Kribi Port on the customs activities of the Douala Port.

Three objectives are set in this study:
- Develop the Concept of Compensatory Residual Effect (CRE) in order to take into account all unobservable exogenous factors likely to affect directly or indirectly the impact indicators during the assessment process.
- Apply the said concept for verifying if the commissioning of the Kribi Port has generated induced effects on the activities of the Douala Port during the past three-year period 2019-2021;
- Estimate the level of activity transfer from Douala Port to Kribi Port.

For the rest of the study, we present the literature review, where some econometric impact assessment tools are developed, working hypotheses, the methodology section where the concept of Compensatory Residual Effect of exogenous factors is developed with a view to dealing with possible bias, Experimental protocol, results, discussion and conclusion.

II.   Litterature Review
Conceptual Framework for Impact Evaluation

This section describes the impact assessment design framework and outlines different classic impact assessment approaches.

The conceptual framework of the impact evaluation was developed by (D. Rubin 1974) when assessing the effectiveness of treatments in the medical field. The model he developed is based on the existence of two latent outcome variables, depending on whether or not an individual receives a treatment.

The literature on impact evaluation issues develops a range of methods which can be targeted to suit the characteristics of the program being evaluated. As (Gertler et al. 2011: 143-149) says, there are four key elements to consider when looking at an evaluation method: [2]timing, coverage, target and resources. The choice

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[1]WIKIPEDIA. http://www.DPA.cm/site/a-propos/histoire-bref/

[2] (1) Timing: whether impact assessment can be built into the program design; (2) Coverage: whether all eligible people can benefit from the program; (3) Targeting refers to the way in which beneficiaries of the program are selected: the selection of individuals can be done by random distribution, by sorting according to eligibility criteria, or by selective targeting; (4) Resources refers to the sufficiency of resources to carry out the impact evaluation.

of an evaluation method often depends on the type of program and of indicators to be evaluated. In macroeconomic context, [3]three main methods are often used:

The ***Before-after approach***. It is a non-experimental approach which consists in comparing certain macroeconomic indicators before and after the implementation of a program *(Robert M. Lloyd 2014). This approach is* most useful in demonstrating the immediate impacts of short- term programs.

The ***Target instruments approach***, which aims to relate the degree of compliance with conditionalities to macroeconomic performance *(J Marcus Fleming 1968).*

The ***With-Without approach***, which compares certain indicators for the targets with the same indicators for groups which are similar to the targets but have not experienced or benefited from the program under evaluation.

In microeconomic framework, two approaches can be referred to notably the subjective reconstruction approach and the counterfactual approach.

Subjective Reconstruction Approach involves having beneficiaries assess the baseline situation by asking them what their behaviour would have been if the program had not existed. [Beneficiaries thus mentally compare their current situation with their memory of their situation before they benefited from the action and identify the changes, which they attribute to the action, between these two situations][4]. As stated by Bruno V. Linden, 2011, this approach avoids the problem of substitution bias, but nevertheless runs a high risk of error due to its subjectivity, since it relies on the memory of the beneficiaries.

Concerning **Counterfactual Approach,** it consists in highlighting the situation that would have prevailed for the targets without the treatment, in order to compare it with the situation resulting from the intervention. More specifically, a counterfactual approach requires the observation of two populations: the intervention group *(treatment group)* and the comparison group *(control group).* Counterfactual approaches include **Experimental designs** which relies on randomized models to select program beneficiaries, creating comparable and statistically equivalent target and control groups. Experimental approaches are very rigorous, and offer simplicity of calculation and interpretation of results. However, it is difficult to carry out these approaches on an ongoing basis, as they can be time-consuming and require expensive equipment (L. Baker, 2000, p. 3). It also includes **Quasi-experimental designs** which are often used when it is not possible to set up target and comparison groups following an experimental approach. Although less rigorous than experimental approaches and subject to biases that affect the reliability of results, Quasi-experimental designs have the advantage of being not only faster but also less costly (L. Baker, 2000). What's more? it can be applied at the end of a program's implementation, without necessarily requiring pre-program baseline data. Quasi-experimental methods include matching on observable characteristics (Lecocq A., Ammi M. & Bellarbre É. 2014) and the double difference method (Michael L. 2010).

About matching method, the strategy is to use a large group of individuals not benefiting from the program to form a control group similar to the group benefiting from the program in terms of observed characteristics. Here, the propensity score is regressed on the said observed variables, enabling matched participants with non-participants, and obtain the average effect by calculating the average difference in results between the two groups.

For the double-difference approach, the principle is also to obtain two groups: one group of beneficiaries and another group identical to the previous one but not benefiting from the treatment. As the name implies, the method operates in two steps: (i) The first is a two-way analysis between the outcome of the indicators for treated and untreated individuals before and after treatment; (ii) The second is the difference of the first two. The latter eliminates any possible bias due to unobservable variants and in particular the difference in outcome that existed prior to the onset of the treatment effect. As well as experimental methods, it exists non-experimental methods based on regression as two-stage Heckman method and the instrumental variables method.

The Issue of Biases in Impact Evaluation

Since the commissioning of the Kribi Port (KP) in March 2018, several events that have occurred have been identified as exogenous factors likely to affect customs activities within the Directorate General of Customs in Cameroon, notably the implementation of the new CAMCIS Customs IT system in September 2019 and the occurrence of the COVID_19 health crisis at the end of 2019 worldwide. Failure to take these factors into account when assessing the induced effects of the commissioning of Kribi Port on Douala Port activities could lead to a biased estimate of these effects. This highlights the issue of bias generally raised in impact assessment studies.

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[3] (J. L. Baker 2000 : p 10-12).
[4](Anais Périlleux & Marthe Nyssens 2016).

Two categories of biases are generally mentioned in impact evaluation, namely **selection bias** and **event simultaneity bias**.

Selection biases

The issue of selection bias generally arises when targeting beneficiaries of a treatment and when seeking a comparison group to the treatment group in order to evaluate the effects of a program. Roy (1951) makes it clear that estimating an equation on a selectively obtained sub-sample of the population can lead to bias. Heckman (1979) presents the selection bias arising from a wage equation estimated only on working women, whereas activity behaviour is the result of a trade-off in which the wage the individual can obtain on the labour market plays a role.

However, three categories of selection biases can be defined. The first two categories refer to *biases arising from differences in observable variables* and *those arising from differences in unobservable variables*. These biases are due to an intentional targeting of the population on which the program is to be applied and are calculated as the difference in the outcome variable between the two populations before the program is started (*Judy L. Baker, 2000*).

Substitution bias can also occur when members of the control group have access to substitutes close to the treatment group. In this case, members of the control group may have access to a program identical to that offered to participants, but offered by another organization.

Event simultaneity bias

It may happen that the effect observed in an evaluation exercise does not solely originate from the program under evaluation, but from external phenomena which affect the entities under study and even the beneficiaries of the program. It is therefore important to isolate the effect of these external factors in order to retain only the effect of the program under evaluation.

Although the evaluation approaches available in the literature make some attempts to avoid bias, the evaluation exercise is sometime limited for the exclusive use of one of these approaches due to the constraints of either the data structure or the evaluation context. So, we develop in this article the concept of: **Compensatory Residual Effect of Exogenous Factors (CRE)**, in order to free the estimated induced effects from any bias coming from unobservable variables or factors.

Working Hypotheses

In order to apply the concept of Compensatory Residual Effect of Exogenous Factors (CRE) developed in the methodology section to the estimation of induced effects, we have formulated three working hypotheses.

Assumption 1: Activities within the Directorate General of Customs in Cameroon were affected by exogenous factors likely to generate losses or gains in activities during the study period.

This first assumption is obvious and is justified by the fact that at least two factors are identifiable during the study period, namely: (i) the COVID 19 pandemic in Cameroon in March 2020, and (ii) the transition from the ASYCUDA customs system to the new CAMCIS Customs information system in Cameroon, which kicked off in September 2019. This hypothesis makes it possible to consider the treatment of temporal effects and simultaneous events in order to minimize related biases.
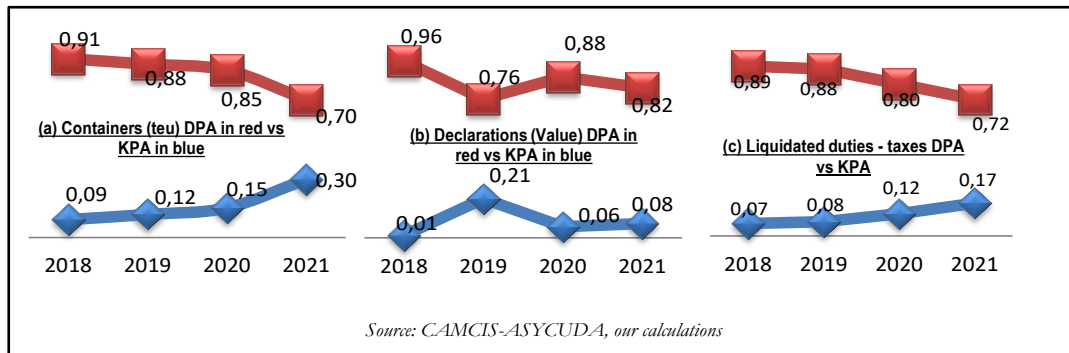
Assumption 2: During the three years of the evaluation, there is a competitive balance[5] within the Directorate General of Customs (DGC) between the DP and the KP, which results in balancing the losses and gains of activities recorded at a given time on both sides between the two ports.

This second assumption assumes that the commissioning of the KP has created a situation of competitiveness which offers operators the choice of carrying out their customs clearance activities in one or other of the two ports concerned. Moreover, it allows the KP to be considered as an endogenous entity to the DGC, so that gains in DGC activities due to commissioning of the KP cannot be considered as exogenous effects. Consequently, it can be established that the differential observed between the achievements of an impact indicator and its counterfactual values at the level of the DGC, constitutes essentially the effect resulting from the combination of exogenous factors, which call in this article the **Compensatory Residual Effect**.

This assumption is reinforced by comparing the evolution of activity weight of the two ports compared to the whole activity at the level of the Directorate General of Customs (*Graph below*). There is symmetry between the curves of these weights of activity in terms of number of containers imported, overall value of declarations, liquidated duties and taxes, which globally expresses the establishment of a competitive situation.

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[5] In the sense of the Pareto optimum, competitive equilibrium implies that economic agents are in such a situation that is impossible to improve the fate of one without reducing the satisfaction of another.

(a) Containers (teu) DPA in red vs KPA in blue — 0,91; 0,88; 0,85; 0,70 / 0,09; 0,12; 0,15; 0,30

(b) Declarations (Value) DPA in red vs KPA in blue — 0,96; 0,76; 0,88; 0,82 / 0,01; 0,21; 0,06; 0,08

(c) Liquidated duties - taxes DPA vs KPA — 0,89; 0,88; 0,80; 0,72 / 0,07; 0,08; 0,12; 0,17

2018 2019 2020 2021

Source: CAMCIS-ASYCUDA, our calculations

Assumption 3: The performance of the global entity (DGC) is the result of aggregating the performance of its sub-entities. This assumption is borne out by the organization of the Customs Department, which is divided into sectors, including Littoral 1, which covers activities at the port of Douala, and Sud 2, which covers activities at the port of Kribi. Using the weight of activity as the aggregation index, the effect of an exogenous factor on a DGC sub-entity corresponds to the effect of that factor captured at DGC level, in proportion to the entity's weight in the whole.

III.   Methodology

The methodology used in this study is structured in five points: (i) development of the concept of Compensatory Residual Effect of exogenous factors (CRE), (ii) data source and definition of impact indicators for evaluation applied case, (iii) evaluation approach, (iv) evaluation period, (v) experimental protocol.

Development of the concept of Compensatory Residual Effect of exogenous factors (CRE)
The concept of Compensatory Residual Effect of Exogenous Factors is developed exclusively in this study.

As noted above, since the Kribi Port was commissioned in March 2018, some events likely to influence activity within the General Directorate of Customs have taken place including (i) the implementation of the new CAMCIS Customs information system in September 2019 to replace the old ASYCUDA system (ii) the outbreak of the Coronavirus in Cameroon on March 6, 2020, leading to the closure of land, air and sea borders on March 16, 2020, as well as restrictions on the movement of people within and without the borders.

Assuming that in addition to the effects generated by the above-mentioned events, there are other unknown factors which have in one way or another influenced activity within the DGC since 2018, the fundamental issue that arises, is to be able to minimize all of the biases possibly generated by the said events during the estimation of the induced effects of the commissioning of the KP. We have therefore developed the **Concept of Compensatory Residual Effect (CRE),** in order to free the results as far as possible from any bias, either of substitution or of simultaneity of events, which could be due to temporal effects that have occurred since the KP was commissioned.

Box 2

> **We define Compensatory Residual Effect on the activities of the Directorate General of Customs as the effect resulting from the combination of exogenous factors on the DGC.**
> **Compensatory Residual Effect is materialized by the differential of the effects obtained from the combination of exogenous factors with a positive effect and exogenous factors with a negative effect.**

Source: Authors

Box 2 means that the Compensatory Residual Effect of all exogenous factors on the activity of the DGC is the differential obtained from the combination of the effects related to COVID 19, to the implementation of the CAMCIS computer system and to other unobservable factors.

Mathematical materialization of Compensatory Residual Effect Concept
Mathematically, for a targeted impact indicator I, the CRE is the difference between the value which would have been achieved without the commissioning of the KP and the value achieved with its commissioning.
Let EFF_i be the effect of an exogenous factor of rang i on an impact indicator I at the overall entity (DGC).

The Compensatory Residual Effect (CRE) of exogenous factors on impact indicator I which materialized activity at the overall entity is: $CRE = \sum_{i=1}^{p} \alpha_i EFF_i$ (1)

p being the number of exogenous factors influencing the activity of the overall entity, and α_i is a combination coefficient.

If I_R is the realized value of the impact indicator I in the presence of KP, and I_P the baseline value obtained if KP had not been commissioned *(counterfactual value)*, the CRE is expressed as follows:

$$CRE = \sum_{i=1}^{p} \alpha_i EFF_i = (I_R - I_P) \qquad (2)$$

For a given sub-entity of rank k, the expression of the **gross induced effect** of the commissioning of the KP is given by: $\qquad GIE_k = (I_{k,R} - I_{k,P}) \qquad (3)$

With $I_{k,R}$ the realized value of the impact indicator I in the presence of the KP in sub-entity k, and $I_{k,P}$ the counterfactual value of this indicator in the absence of the KP in sub-entity k.

Net and Relative induced effect of the KP

Based on the three working hypotheses formulated above, the Compensatory Residual Effect on each sub-entity is obtained by imputing the CRE in proportion to the weight of that sub-entity in the whole.

Thus, the **net induced effect** related to the commissioning of the KP is the difference between the gross induced effect and the Compensatory Residual Effect at the sub-entity housing Douala Port (DP). Hence the following expression:

$$EFFind_k = GIE_k - P_{k,I} \times RCE = (I_{k,R} - I_{k,P}) - P_{k,I} \times (I_R - I_P) \quad (4)$$

With k representing sub-entity housing the DP, and $P_{k,I}$ the weight of sub-entity k in the set relative to indicator I.

$P_{k,I} \times RCE$ represents the Compensatory Residual Effect at the sub-entity housing DP.

The Relative Induced Effect is obtained by relating the net induced effect to the counterfactual value of the indicator, thus:

$$EFFind_{rel_k} = \frac{EFFind_k}{I_{k,P}} \qquad (5)$$

Definition of impact indicators for evaluation applied case

For applying the Concept developed above to assess the induced effects generated by launching of Kribi Port on Douala Port customs activity over the 2019-2021 three-year periods, we distinguish two groups of impact indicators in relation to the indicators generally analysed in the framework of the monitoring and evaluation of activities within the Cameroon Customs Administration.

Activity indicators which include: number of 20-foot equivalent containers recorded annually at import, number of declarations cleared annually in customs, value of declarations cleared annually in customs.

Performance indicators which include: annual customs revenue.

Evaluation approach

The approach used in this study combines the ***with-without approach*** (**WWM**)[6] with the principle of the double-difference method. The with-without approach is often used in the case of structural adjustment policies to assess the situation of countries having undergone structural adjustment program compared to the situation of similar countries not having undergone such program (Judy L. Baker 2000: 11-12). In this study, we compare the situation of activities in the Douala Port in the presence of the KP with the situation of activities without the KP.

Data Source and Evaluation Period

The data used in this paper is drawn from the databases of the existing customs information systems in Cameroon, notably ASYCUDA and CAMCIS. Given that the launch of commercial operations at the KP has took place at 02 March 2018, the evaluation of the induced effects has been carried out over the period from 2019 to 2021.

Experimental Protocol

The process of estimating induced effects of the commissioning of the KP was carried out in two stages, namely (i) estimation of counterfactual values of impact indicators, (ii) estimation of induced effects.

Estimation of counterfactual values

Assessing the effects induced on an impact indicator requires both the achieved value and the counterfactual value of this indicator over the evaluation period. By counterfactual values we mean the values that would have prevailed over the said period if the Kribi Port had never been commissioned. The

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[6]The "With Without Method" was used by (Antonella Puca & Mark L. (2019) in the field of finance to estimate the value of an intangible asset. The difference between two discounted cash flow models is calculated: one representing the status quo for the firm with the asset in place, and one representing the status quo without the asset in place.

counterfactual values of the impact indicators for the years 2019, 2020 and 2021 have been obtained by carrying out a baseline scenario based on the historical values of the said indicators on the period 2007–2018.

The forecasting model used to obtain the baseline values is the double exponential smoothing applied on the annual series. This model is one of the oldest and most studied time series forecasting method that is more suitable for the time dimension of the available data.

Estimation of Induced Effects and Treatment of Bias.

Based on the baseline scenarios obtained from the forecasting model, the net induced effect of the commissioning of the KP is obtained by making the difference between the actual and counterfactual values of the impact indicators.

To avoid the common trend assumptions that support the difference and differences approach, we apply the Compensatory Residual Effect concept as developed above associated with the three working hypotheses that make it possible to quantify the possible biases and to extract them from the gross effect previously calculated to finally obtain the net induced effect free of any bias.

IV.   Results

We now present the results of the evaluation of the induced effects of the commissioning of the KP on the customs activities of the Douala Port. The induced effects are calculated for each impact indicator and presented in tables the menu of which shows the following fields:

- **Year**: this refers to the last three years which constitute the evaluation period;
- **DP baseline scenario**: the values that would have been obtained for the indicator over the evaluation period in the absence of the commissioning of the KP *(counterfactual value)*;
- **DP Achievement**: these are the values actually obtained for the impact indicator at the DP;
- **Gross effect**: the difference between the achieved values and the counterfactual values.
- **CRE**: Compensatory Residual Effect which materializes all the temporal effects due to exogenous factors that influenced activity within the Directorate General Customs;
- **DP weight:** weight of the activity of the Douala Port's in overall customs activity;
- **Net induced effect**: it is effectively the effect generated by the commissioning of the Kribi Port on the activities of the DP. A negative net induced effect means that the commissioning of the KP has a downward impact on the DP customs activity by a value equal to the absolute value of the net induced effect.
- **Relative effect:** Net Induced Effect related to the counterfactual value of the indicator.

Induced Effects on Activity Indicators

Induced effect of the commissioning of the KP on the number of containers (TEU) imported into the Douala Port (DP)

The commissioning of the Kribi Port in March 2018 has gradually affected the number of twenty-foot equivalent containers (TEU) imported into the DP. Indeed, the DP recorded a decrease of 8 869 containers in 2019 relative to the level of imports achievable in the same year in the absence of the Kribi Port *(Table 1)*. This decrease corresponds to a relative induced effect of 6%. In 2020 and 2021, the drop increased to 13 904 and 37 406 containers (TEU) respectively, meaning relative induced effects of 9% and 24%.

Table A.1: Induced effects of the commissioning of the KP on the number of containers (teu) imported at the DP

Year:	DP baseline scenario	DP achievement	Gross effect	CRE	DP weight	Net induced effect	Relative effect
2019	145 211,1	132 138,0	- 1 073,1	- 4 765,2	0,88	- 8 869,6	-6%
2020	150 418,8	161 525,0	11 106,2	29 528,3	0,85	- 13 904,9	-9%
2021	155 626,5	157 860,8	2 234,3	56 257,8	0,70	- 37 406,6	-24%

Source: CAMCIS, ASYCUDA and our calculations

Induced effects of the commissioning of the KP on import declarations recorded at the DP

In terms of numbers of declarations recorded at DP, there is a small decrease of 1 477 declarations recorded at import in 2019, 8 518 in 2020 and 14 734 in 2021 compared to the number of declarations likely to be recorded in these three years in the absence of the KP which corresponds to relative induced effects of 2% in 2019 14% in 2020 and 26% in 2021 *(Table 3)*.

Table A.3: Induced effects of the commissioning of the KP on the number of declarations recorded at the DP

Year:	DP reference scenario	DP achievement	Gross effect	CRE	DP weight	Net induced effect	Relative effect
2019	63 484,0	64 246,0	762,0	4 140,4	0,54	- 1 477,5	-2%

| 2020 | 60 040,9 | 83 036,0 | 22 995,1 | 69 138,7 | 0,46 | - 8 517,8 | -14% |
| 2021 | 56 597,7 | 92 135,0 | 35 537,3 | 133 820,0 | 0,38 | - 14 733,9 | -26% |

Source: CAMCIS, ASYCUDA and our calculations

In value terms, the impact becomes much more significant as the relative induced effects are 19% in 2019, 9% in 2020 and 16% in 2021 translating into a decrease in the liquidated value of CFAF 768 billion in 2019, 377 billion in 2020 and 676 billion in 2021 compared to the levels achievable by the DP in the absence of the KP in each of these years *(Table 4)*.

Table A.4: Induced effects of the commissioning of the KP on the liquidated value of the DP (in trillion FCFA)

Year:	DP reference scenario	DP achievement	Gross effect	CRE	DP weight	Net induced effect	Relative effect
2019	4,1	3,4	-0,6	0,2	0,72	-0,7	-19%
2020	4,1	4,4	-0,3	0,87	0,82	-0,4	-9%
2021	4,2	5,4	-1,2	2,4	0,77	-0,6	-16%

Source: CAMCIS, ASYCUDA and our calculations

Induced Effects on Performance Indicators

Given that the Customs Sectors are evaluated according to their contributions to the achievement of the revenue targets assigned to the Directorate General of Customs in the framework of the budgetary programming of the State, the performance-related impact indicators selected is customs revenue.

Induced effect of the commissioning of the KP on the amount of customs revenue at the Douala Port

Since 2019, customs revenue at the DP has been gradually affected by the commissioning of the KP. Although the effects were not significantly felt in 2019 (2%) there was a significant increase in the said effects in 2020 (11%) and 2021 (20%). This translates into a decrease of customs revenue of around CFAF 13,4 billion in 2019, CFAF 92,4 billion in 2020 and CFAF 174,7 billion in 2021 compared to the levels that would have been achieved by the port during these years if the KP had not been commissioned (Table 5).

Table A.5: Induced effects of the commissioning of the KP on customs revenue at the DP (in billion CFAF)

Year:	DP baseline scenario	DP achievement	Gross effect	CRE	DP weight	Net induced effect	Relative effect
2019	797,9	817,9	19,8	41,3	0,81	-13,5	-2%
2020	827,5	772,9	-54,6	51,6	0,73	-92,4	-11%
2021	857,2	750,4	-106,8	103,4	0,66	-174,7	-20%

Source: CAMCIS, ASYCUDA and our calculations; values in millions.

Analysis of the level of transfer of activities from the Port of Douala to the Port of Kribi

We evaluate the level of transfer of activities by relating the net effect induced to the level of realization of activities at the port of Kribi. Concerning customs revenue, it emerges that 18% of customs revenue achieved at the KP in 2019 comes from the migration of customs activities from the DP. In 2020 and 2021 the level of customs revenue at the KP coming from migration of activities from the DP reached to 75% and 88% respectively. *(Table 10)*.

Table A.10: Rate of transfer from the Douala Port to the Kribi Port (in billions of CFA francs)

Year	Overall customs revenue		
	KP achievement	DP impact	Migration rate
2019	76,2	-13,5	-18%
2020	124,0	-92,4	-75%
2021	198,0	-174,7	-88%

Source: CAMCIS, ASYCUDA and our calculations; values in billions.

V.   Discussions

In the field of Port studies, few studies address the issues of evaluation as formulated in this article. While port competitiveness issues are most often raised, the approaches generally used are qualitative, and more often the hierarchical analysis process developed by Thomas L. Saaty (1970). Among others, we can cite Douglas N. Hales *et al* (2016) who worked on "An Empirical Test of the Balanced Theory of Port Competitiveness" using the Hierarchical Analysis Process (AHP); Yuen Chi-lok A. *et al* (2012) who also explored the relative importance of the determinants of container port competitiveness from the perspective of users, using the Analytical Hierarchy Process (AHP) and Chinonye U. *et al* (2006) who conducted a study to determine the characteristic factors of port choice by shippers in Nigeria and use the Analysis Hierarchical Process (AHP) approach and apply it to four ports.

The concept of Compensatory Residual Effect, as developed in this article, makes a significant contribution to the ex-post assessment of port competitiveness. The method developed enables us to quantitatively assess the impact that the establishment of a new port would have on existing ports within a cluster. Finally, we can add that this new concept of Compensatory Residual Effect (CRE) can also be applied to evaluation studies within organizations such as banks, provided that the assumptions made in this paper are verified.

VI.   Conclusion

We have developed in this article the Compensatory Residual Effect concept in order to minimize the biases possibly due to some exogenous factors not originally planned as part of a program. By applying this concept to the assessment of the induced effects of the commissioning of the Port of Kribi in Cameroon on the customs activities of the existing Port of Douala, it emerged that the entry into service of commercial operations at the Kribi Port on 2 March 2018 has globally affected the customs activities and the performances of the Douala Port over the three years that followed. Overall, the growth of the induced effects of the commissioning of the KP is accelerating over the years. This is particularly the case for the induced effects on the number of containers (TEU) imported which goes from 6% *(a drop of 8 869 compared to the level achievable in the absence of the KP)* in 2019 to 24% *(a drop of 37 407)* in 2021 as well as for the number of maritime manifests registered for imports where the induced effects go from 2% *(a drop of 17)* in 2020 to 4% *(a drop of 37)* in 2021. Induced effects on taxable values range from 9% *(decrease of 377 billion)* in 2020 to 16% *(decrease of 676 billion)* in 2021. For customs revenue the induced effects go from 11% *(a drop of 92.4 billion)* in 2020 to 20% *(a drop of 174.7 billion)* in 2021.

In terms of activity transfers, 13.5, 92.4 and 174.7 billion FCFA of customs revenues from Douala Port were transferred to Kribi Port in 2019, 2020 and 2021 respectively, representing 18%, 75% and 88% of the Port of Kribi's activities in these years.

Based on these results therefore, it is recommended an in-depth diagnostic study on the factors determining the attractiveness of the two ports, in order to establish port competitiveness which could contributes to the optimization of economic performance at the national level.

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