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Effects of the Diversification of Nontimber Forest Products on Human Development in Congo: The Case of Gnetum, Marantaceae and Rattan

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Abstract

The objective of this paper is to analyze the effects of the diversification of nontimber forest products (NTFPs) on human development in Congo. An error correction model (VECM) is used to achieve this objective. The estimates are based on data from the statistical yearbooks of the Ministry of Forest Economy (MEF) from 2018, UNDP in 2019, World Bank in 2020 and FAO 2018. The results show that in the Congolese context, particularly in the forestry sector, NTFP diversification has no effect on human development in the short term. In contrast, in the long term, the effect of NTFP diversification on human development is positive and significant. These results suggest the need for, on the one hand, the implementation of policies for the conservation, protection and rational exploitation of forests and, on the other hand, the continued implementation of initiatives to combat the abusive exploitation of NTFPs.

Keywords

Non-Timber Forestry Products, Human Development, Congo

1. Introduction

Over the past ten years, the human development index (HDI) scores of sub-Saharan African countries have increased, from 1.04% in 2010 to 1.09% in 2015; however, this continent faces development problems and is not attaining the common indicators of human well-being, i.e., literacy, nutrition, health and life expectancy. In the Congo, according to the National Human Development Report (RNDH, 2021), the HDI rose from 0.503 in 2005 to 0.591 in 2014 and to 0.608 in 2018.

This progression is due, on the one hand, to oil exploitation and, on the other hand, to the diversification of nontimber forest products (NTFPs) in general and, specifically, the leaves of Gnetum and Marantaceae and the stems of rattan, which are necessary for improving the living conditions of the Congolese population (Ndoye & Awono, 2005; Biloso, 2008; Sah, 2018). This development progression, according to NHDR (2021), is the process that leads to the expansion of opportunities for all people to lead long and healthy lives, become educated, obtain sufficient resources to enjoy a decent standard of living, and enjoy sufficient civil and cultural freedoms to participate in community life.

The diversification of forest and nonforest activities offers certain benefits, including increased trade, high capital and labor productivity. These benefits, when combined with sound and efficient public management, can contribute to human developmental welfare (Loubelo, 2012; Koffi et al., 2017). The latter is likely to affect various human development objectives; hence, there is a need to examine the effects of NTFP diversification on human development in Congo. The problem of determining the effects of NTFP diversification and human development remains a great challenge both in the literature and in the evidence base.

There are two opposing arguments in the literature. On the one hand, there are works by Mialoundama (1993), Arnold and Dewées (1995), Powell (2012), Bikoué and Essomba (2006), Bayala et al. (2014), who argue that the diversified marketing and consumption of NTFPs play an important role in improving human development. In this regard, Powell (2012) and Bayala et al. (2014) calculate that the diversified marketing and consumption of these forest products contribute up to 30% of dietary protein and minerals for local populations; therefore, these products allow people to be healthy and have access to the financial resources necessary to enjoy a decent standard of living. On the other hand, works by Ndoye (1995), Pouliot et al. (2012), and Neudeck et al. (2012) postulate that the effect of the diversified exploitation of NTFPs on human development is marginal or even negative or neutral. According to these authors, the diversification of NTFP exploitation by uprooting certain plant species is a practice that is responsible for reductions in forest potential in the short and medium term. This practice thus hinders the development of these resources to satisfy vital needs of the population.

In fact, the diversified marketing of NTFPs in the major cities of Congo has generated nearly two thousand jobs since 1997, distributed as follows: rattan stems, 106; Marantaceae leaves, 260; and Gnetum, 1450 (Mialoundama et al., 2008). These jobs ensure subsistence conditions and improve the living conditions of the employees by providing significant income to cover health care, rent payments, school fees for children, water and electricity (Mialoundama et al., 2006; Ruiz-Perez et al., 2000; Loubelo, 2012).

In this regard, knowledge of the diversified consumption and marketing of Gnetum leaves, Marantaceae and rattan stems remains an important element in

improving human development. In Congo, these forest products are used for various purposes. These products are intensively consumed and traded in major national and international markets (Loubelo, 2012). To this end, the consumption and trade of these products constitute, without a doubt, a substantial source of protein and income that can help Congolese people achieve security in their daily lives.

Similarly, since 1991, the Congo, in collaboration with the FAO, has sought to promote, develop and diversify these forest products that enable the population to improve their living conditions. These forest products are particularly important in that they contribute to animal feed and fodder (Shackleton et al., 2007). They are also used for therapeutic purposes and are the subject of important commercial activities that generate substantial income for the populations living in the forests. Given their importance, these forest products deserve better management and better diversification of their economic chain. Thus, our research question is as follows: what are the effects of the diversification of NTFPs on human development?

The overall objective of this paper is to analyze the effects of NTFP diversification on human development. Given the nutritional contributions of NTFPs and their contributions to job creation, we support the hypothesis that NTFP diversification contributes positively to human development.

The rest of this work is structured as follows: the second section is devoted to a review of the literature; the third section addresses the methodology; and the fourth describes the development of the model and the interpretation of the results. Finally, the fifth section provides the conclusion.

2. Review of the Literature

The effects of NTFP diversification on human development have been the subject of abundant theoretical and empirical literature.

Theoretically, it is possible to divide the literature into two groups. On the one hand, Hecketsweiler (1991), Mialoundama (1993), Powell (2012), and Bayala et al. (2014) argue that the diversified marketing and consumption of NTFPs play an important role in improving human development. On the other hand, Ndoye (1995), Pouliot et al. (2012), and Neudeck et al. (2012) relativize this view by highlighting the dampening effect of NTFP diversification on human development.

With regard to the first group, the pioneering work of Hecketsweiler (1991) and Mialoundama (1993) supported the idea that the diversified consumption and marketing of NTFPs are an important source of livelihood and income that help to solve some of the relevant problems related to improving household living conditions. Indeed, it has been found that the income resulting from the diversified marketing of NTFPs has real effects on household consumption and savings (Tchatat, 1999). Thanks to this income, these households are able to support schooling and health care for their dependents (Mialoundama, 1993). In

this regard, Mialoundama (1985) and Powell (2012) note that in addition to the income that NTFPs bring to households, these forest products, such as Gnetum leaves, constitute a substantial source of protein and have a relatively high mineral content (16% to 18%, depending on the species considered). The presence of eight (8) essential amino acids in Gnetum leaves endows them with high nutritional value; in addition, these leaves are generally a valuable supplement due to the vitamins and mineral salts they contain and therefore support long and healthy lives for Gnetum consumers.

In the second group of works, some authors, namely, Ndoye (1995), Bikoué and Essomba (2006) and Neudeck et al. (2012), have put forward a theoretical argument regarding the existence of a negative relationship between the diversified exploitation of NTFPs and the improvement of human living conditions. To this end, it has been found that the high demand for the diversified commercial exploitation of NTFPs is met in an abusive and anarchic manner, with unsustainable harvesting techniques (Ndoye, 1995). These harvesting practices make it difficult for households to earn enough income to pay for health care, rent, and schooling for their children. In the same vein, Bikoué and Essomba (2006) have found that when these exploitation practices persist, they can lead to deforestation and the disappearance of certain species, which can be harmful to human development. According to Pouliot et al. (2012), most forests are undergoing deforestation or degradation processes of varying degrees of severity, with negative effects not only on ecosystems but also on people's lifestyles. The diversified exploitation of NTFPs is one of the main causes of deforestation and forest degradation, which are detrimental to human health and living conditions (Ndoye, 1995).

The theoretical literature shows that it is difficult to predict the effects of NTFP diversification on human development, and these studies have led to highly controversial empirical conclusions. We therefore distinguish between studies that point to the positive effects of NTFP diversification on human development on the one hand and studies that show the opposite results on the other.

In terms of empirical studies that support the existence of positive effects of NTFP diversification on human development, many authors, such as Tabuna (1999), Koffi et al. (2017), and Sah (2018), consistently assert the existence of a positive relationship between diversified NTFP harvesting and human living conditions.

To characterize such a relationship, Ndoye & Awono (2005) and Mialoundama et al. (2008), using the focus group model in Cameroon and Congo, showed that more than fifteen million people living in these countries make a living from the collection of NTFPs, including *Gnetum africanum* leaves. These leaves are one of the vegetables that are most appreciated by households for several reasons, including their taste (57.8%) and nutritional value. As such, NTFPs are of great interest and contribute in no small part to improving the living conditions of these populations. In the same vein, Biloso (2008), Loubelo (2012) and

Koffi et al. (2017), using a probit model, the focus group approach and a logit model in the Democratic Republic of Congo, Congo and Burkina Faso, showed that the diversified marketing of NTFPs has income effects that allow households to meet other needs (rent payments, children's schooling expenses, water, electricity and health care).

In the same vein, in South Africa and East Africa, authors such as Vedeld et al. (2007) and Maruod et al. (2015), using focused groups and analysis of variances, obtain the same results as Loubelo (2012) and Koffi et al. (2017). These authors showed that over 65% of the African population obtained income from the sale of these forest products. These authors estimate that the sale of these products provides the population with very important income to address urgent and unpredictable household problems (such as health care, water, education and electricity). The consumption and diversified marketing of NTFPs can help to improve the living conditions of these populations.

Furthermore, it should be noted that, while several authors (Tabuna, 1999; Maruod et al., 2015; Koffi et al., 2017) have found that the diversification of NTFPs favors the improvement of people's living conditions, others (Loubelo & Mialoundama, 2002; Koubouana, 2008; Katembera et al., 2015) have found that it does not favor the improvement of human living conditions.

In this regard, in a survey conducted by Loubelo and Mialoundama (2002) and Koubouana (2008) in Congo, the results showed that the diversified exploitation of NTFPs by felling trees or uprooting certain plant species was responsible for reducing the productive forest potential in the short and medium term. The same authors (Loubelo & Mialoundama, 2002; Koubouana, 2008) point out that when the demand for NTFPs is clearly greater than the supply, unplanned NTFP exploitation occurs. Under these conditions, operators or harvesters proceed by felling the plant/stem, regardless of its diameter or intended use (consumption as food, other commercial use, or medicinal use). These practices are factors contributing to the deterioration of the living conditions of the local populations.

Similarly, Katembera et al. (2015), in a survey conducted in the Democratic Republic of Congo (DRC), revealed that population growth, shifting cultivation and industrial wood exploitation are factors exacerbating the degradation of forests or the scarcity of certain forest products. In these situations, people have difficulty earning income to meet the costs of health care, rent, education and electricity. In the same vein, Mitchell (2004) and Shaheen et al. (2016), working on data from Kenya, Congo and Pakistan obtained through focus groups, found that NTFP consumption has positive effects on deforestation and forest degradation, which are not conducive to improving people's living conditions.

Two lessons can be drawn from the theoretical and empirical literature. The first lesson is that work in the Congo is virtually absent. To this end, this work contributes to the literature on the effects of NTFP diversification on human development in Congo. The second lesson is that the results in the literature are

nonlinear. Some authors (Tabuna, 1999; Koffi et al., 2017) believe that NTFP consumption tends to improve human development, and others (Loubelo & Mialoundama, 2002; Koubouana, 2008; Shaheen et al., 2016) believe that it does not allow populations to cope with urgent and unpredictable household problems (such as health care, water, education and electricity).

3. Methodology

In order to achieve our objective, we conduct an econometric analysis below. First, however, we describe the development of our index and present the elements of the methodology, from the model to the analysis of the results.

3.1. Construction of the NTFP Diversification Index (NTFPDI)

The economics literature provides two approaches to diversification index construction: the first approach involves the composite specialization index, and the second approach combines the ogive and entropy indices as well as Hirschman's index. These indices are similar in design and can be used interchangeably. To this end, the NTFP diversification index in this article will be constructed based on the ogive index. This index measures the diversification or concentration of NTFP export earnings. Hence:

$$\text{IDPFNL} = N \cdot \sum_{i=1}^{N} \left(Pi - 1/N \right)^2 \quad (1)$$

where $Pi = \left(xi/X \right)$ is the actual share of product $i\left(xi \right)$ in total NTFP exports ($X = \Sigma xi$), N is the total number of NTFPs exported, and $1/N$ is the "ideal" share of NTFP revenue, which is the average export share of each product.

3.2. Presentation of the Model

Based on the model of Sah (2018), the implied form of our equation is as follows:

$$Y = f\left(\text{IDPFNL}, X \right) \quad (2)$$

where:

Y: a variable that represents human development.

NTFPDI: the NTFP diversification index.

X: the set of control variables.

3.3. Estimation Equations

Equation (1) below will be presented as follows:

$$\text{IDH}_t = \beta_0 + \beta_1 \text{ IDPFNL}_t + \beta_2 \text{Surf\_Forest} + \beta_3 \text{Cons\_Energ} + \beta_4 \text{Services} + \epsilon_t \quad (3)$$

where:

NTFPDI: NTFP diversification index;

HDI: Human Development Index;

Surf_Forest: the forest area from which these nontimber forest products are extracted;

Cons_Energ: energy consumption as a percentage of the GDP per capita;

Services: the proportion of the service sector in national production.

3.4. Table of Expected Signs and Data Sources (Table 1)

Table 1. Expected signs and data sources.

Variables	Sources	Years	Expected signs
IDPFNL	MEF	2018	+
IDH	PNUD	2019	+
Surf_Forest	FAO	2018	+
Cons_Energ	WDI	2020	+
Services	WDI	2020	+

Source: Author, from the literature.

3.5. Estimation Procedure

The estimation of an econometric model is conditioned on the stationarity of the variables. In other words, the variables must be integrated in the same order. In this study, the variables are examined using three tests of stationarity: the augmented Dickey-Fuller (ADF) test, the Phillips and Perron (PP) test and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. The use of the last is conditioned on the fact that the variables under study must be normally distributed. The normal distribution of the variables is determined on the basis of their descriptive statistics, in this case, the Jarque-Bera coefficient and its associated probability.

Table 2 presents a summary of the descriptive statistics of the variables under study. The results in this table show that, on the one hand, the HDI there is a small concentration (lowest standard deviations) around the mean value, followed by the variables IDPFNL and Cons_Energ, which also have low standard deviations. These low dispersions are justified by the fact that Congo is an underdeveloped country that exploits its forest products less than other countries. On the other, the high dispersion of Surf_Forest and services is justified insofar as Congo has high energy consumption and growing forestry potential. However, given the sample size of 34 observations following the study period from 1985 to 2018, it is possible to assume that the probability distribution of this variable converges to a normal distribution.

Table 3 summarizes the results of the stationarity tests obtained in Stata 2014 by the ADF, PP and KPSS stationarity tests. The results show that some of the variables in the study are stationary in level and that others are stationary in first difference. However, a variable that is stationary at a lower level is also stationary at a higher level, so we can conclude that all the variables are stationary in the first difference. In other words, the variables used in this work are first-order stationary. Since the variables are not integrated of the same order, there is a presumption of the existence of a long-term relationship.

Table 2. Descriptive statistics.

	HDI	IDPFNL	Surf_Forest	Cons_Energ	Services
Mean	0.539	0.716	12.325	2.943	35.666
Maximum	0.613	0.900	12.333	4.386	56.216
Minimum	0.49	0.145	12.315	2.056	18.909
Std. Dev.	0.037	0.213	0.006	0.722	12.025
Observations	34	34	34	34	34

Source: Author's calculations.

Table 3. Results of the stationarity tests.

Variable Type of test	Test	With constant and without trend	With constant and trend	Critical values at 5%	Test statistic	Decision
IDH	ADF	Oui	Oui	−3.557	−4.282	I(1)
	PP	Oui	Oui	−3.557	−4.248	I(1)
	KPSS	Oui	Oui	0.146	0.175	I(0)
IDPFNL	ADF	Oui	Oui	−2.954	−5.200	I(0)
	PP	Oui	Oui	−3.552	−5.259	I(0)
	KPSS	Oui	Oui	0.146	0.196	I(1)
LSurf_forest	ADF	Oui	Oui	−2.957	−3.795	I(1)
	PP	Oui	Oui	−2.957	−3.728	I(1)
	KPSS	Oui	Oui	0.146	0.180	I(1)
Cons_Energ	ADF	Oui	Oui	−2.957	−5.581	I(1)
	PP	Oui	Oui	−3.557	−5.696	I(1)
	KPSS	Non	Oui	0.146	0.183	I(0)
Services	ADF	Oui	Oui	−2.957	−7.137	I(1)
	PP	Oui	Oui	−3.557	−8.212	I(1)
	KPSS	Non	Oui	0.146	0.157	I(0)

Source: Author's calculations.

Johansen Cointegration Test

To carry out the cointegration test, the determination of the optimal number of lags (P) is taken into account in the vector autoregressive model [VAR(p)]. For this, we estimate a number of autoregressive processes and retain the one that minimizes the loss of information. This is determined on the basis of the Akaike information criterion (AIC). The execution of this procedure leads to the results contained in the appendix (fig. A). The figure shows that the optimal number of lags to be taken into account to minimize the loss of information, according to the AIC, is $p^* = 2$. At this level, the AIC indicates that the minimum information loss is achieved. Knowledge of the optimal number of delays and the fact that the variables are integrated of the same order allows us to assume that those inte-

grated in level are in difference. Hence, this allows us to perform the Johansen cointegration test to determine whether there is a long-term cointegrating relationship between the variables. The results of this test are summarized in fig. B in the Appendix. The results of the Johansen test show the existence of at least two long-term cointegration relationships. Under these conditions, the use of the vector error correction method (VECM) is essential for the estimation of the parameters, the results of which are summarized in fig B in the Appendix.

4. Results of the Model Estimation

The results of the estimation are divided into the results related to the speed of adjustment towards the long-term target, the results of the estimation of the long-term model and the results of the estimation of the short-term model. The results are presented first and then discussed. We note that the exogenous variables retained in this work explain the endogenous variables to the extent of 0.7321, i.e., an R^2 = 73.21%. According to the estimation results, the model to be retained is D (IDH), which presents a negative recall force that is significantly different from zero (−0.285; [−5.33]). This confirms the existence of an adjustment relationship towards long-term equilibrium. Table 4 represents the recall forces of the different models.

To validate the VECM, we use the Lagrange multiplier autocorrelation test (see appendices). The first- and second-order statistics of the Lagrange multiplier test confirm the absence of autocorrelation. Indeed, the probabilities associated with these two statistics are greater than 0.05, so the null hypothesis of "white noise" is accepted. Table 5 presents the results of the estimation of the short-term model. The results in the table show that in the short term, the NTFP diversification index has no effect on human development. This result is consistent with those in some works in the literature, namely, the study of Koubouana (2008) in the Congo, which revealed the unplanned exploitation of forest products by operators or harvesters felling plants/stems, regardless of their diameter, for consumption or marketing.

Table 6 presents the results of the model estimation in the long term. This table shows that in the long term, IDPFNL has a positive and significant effect on human development. Indeed, an increase in IDPFNL, all other things being equal, leads to an increase in the human development index of 11.9 points. This result can be explained by the theory of renewable and nonrenewable natural resources.

This result can be considered the same as those obtained by Tabuna (1999),

Table 4. Speed of adjustment towards the long-term target (recall force).

D (IDH)	D (IDPFNL)	D (Surf_Forest)	D (Cons_Energ)	D (Services)
−0.285***	−1.691	−0.011***	1.570	−5.784
[−5.33]	[−0.55]	[3.11]	[0.58]	[−0.11]

Source: Author's calculations. Note: The values in square brackets are the results of Student's t-test; **represents significance at the 5% level; ***represents significance at the 10% level.

Table 5. Results of the short-term model estimation.

Equation	Human Development Index
Human Development Index (−1)	0.385*** (2.86)
Index of diversification of nontimber forest products	−0.002 (−0.62)
Forested area	9.714*** (3.47)
Energy consumption per inhabitant	−0.004 (−0.84)
Service sector	0.0002 (1.28)
Constant	0.005*** (−3.27)

Source: Author's calculations.

Table 6. Result of the long-term model estimation.

Equation	Human Development Index
Human Development Index (−1)	1.000
Index of diversification of nontimber forest products	0.119** (−2.04)
Forested area	8.673* (−1.89)
Energy consumption per inhabitant	0.192*** (−7.59)
Service sector	0.003*** (2.68)
Constant	0.005*** (−3.27)

Source: Author's calculations. *, **, *** significant at the 10%, 5%, and 1% thresholds, respectively; values in parentheses are the results of Student's t-test.

Loubelo (2012) and Koffi et al. (2017) in Cameroon, Congo and Burkina Faso, respectively; the last showed that these products contribute enormously to household consumption and income.

- **Interpretation and discussion of results**

The results of the vector error correction method (VECM) estimation show that in the long term, the NTFP diversification index has a significant influence on human development in Congo.

There are at least two explanations for this result. The first is that the commercialization of NTFPs provides households with sufficient income to meet their daily needs, while the second relates to the consumption trends for these forest products.

1) Households have sufficient income to meet their daily needs

Nearly 70% of Congolese people depend on the manufacture and sale of rat-

tan, *Gnetum africanum* leaves and Marantaceae leaves for subsistence and to meet their financial needs. For a retailer, a package of *Gnetum africanum* or Marantaceae leaves bought in a village at a unit price of 50 or 100 F CFA can be brought to the retail markets at a price of 150 or even 250 or 500 F CFA. This can generate between 100,000 and 250,000 CFA francs per month. On the other hand, a wholesaler with a single vehicle making two to three trips per week can transport quantities ranging from 1560 to 1620 kg of Gnetum leaves and Marantaceae and 895 feet of rattan vines. Selling or processing these quantities corresponds to a gross net income ranging from 7,580,000 CFA francs for Gnetum leaves to 5,150,000 CFA francs for Marantaceae leaves and 3,975,000 CFA francs for rattan stems. These incomes vary because some products are seasonal, though Gnetum is present on the market consistently throughout the year.

The income from the sale of these products allows households to pay for schooling, rent, electricity, water and health care for their dependents. With this income, women sellers are able to handle the same concerns as civil servants or private sector employees. Through various informal channels, these products offer employment opportunities and generate income for many households involved in their exploitation and marketing. Income from the marketing of Gnetum, Marantaceae and rattan leaves enables households to cope with occasional and predictable problems of life. This is because the forests of the Congo have enormous NTFP potential that provides households with significant income. Under these conditions, it is obvious that the diversification of forest products into *Gnetum africanum*, Marantaceae and rattan leaves in the long term could have a significant influence on human development in Congo.

2) NTFP consumption habits

The various NTFP consumption habits of households in the Congo are primarily a function of ancestral customs applied for health improvement. These forest product consumption patterns can be classified into a few basic patterns based on the nature of the staple food, the origin of the consumed fat, and the means by which the need for essential proteins is satisfied. This primary framework then makes it possible to characterize habitual diets by defining secondary or accessory foods that are used on a purely incidental and sporadic basis or, on the contrary, are true emergency food sources to improve household health. To this end, these products (Asparagus, Aframomum, Cola, Gnetum, Marantaceae and safou) are very important for household nutrition, and households benefit from these products by obtaining protein and achieving better household health.

In the same way, the leaves of Gnetum make up a part of the diets of all social strata in Congo because of their price, and they represent a substantial source of proteins and mineral elements. The presence of eight (8) essential amino acids in Gnetum leaves confers their high nutritional value; moreover, they generally provide a substantial contribution to dietary vitamins and mineral salts. The leaves of Gnetum, Marantaceae and rattan are the main forest products consumed by households that make notable contributions to improving human health.

5. Conclusion and Policy Implications

The objective of this paper was to analyze the effects of NTFP diversification on human development in Congo. To achieve this objective, we performed an econometric analysis using the vector error correction method (VECM). After applying quantitative techniques, particularly those from the forestry sector, we found that in the short term, the NTFP diversification index will have no effect on human development in Congo. In the long term, however, NTFP diversification is projected to have a significant effect on human development in Congo. There are at least two explanations for this result. The first is that NTFPs provide households with sufficient income to meet their daily needs; the second is that the consumption of these forest products benefits human development. These explanations of these results validate the hypothesis proposed in this article.

The Congo is a forested country with enormous potential in timber and non-timber forest products. On the basis of these results, some policy implications can be considered. On the one hand, it is essential that decision-makers establish policies for the conservation, protection and rational use of forests; on the other hand, these decision-makers must continue to implement initiatives to combat the abusive exploitation of forests.

The main limitation of this paper is the lack of a field survey of households, which was not performed due to financial constraints. Such a survey would allow qualitative data models to be used to better capture the effects of NTFP diversification on human development. This weakness is an avenue that could be explored in future work if sufficient funding can be obtained.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix

These Table A1 and Table A2 represent respectively the results of the short- and long-term VECM model of the effects of non-timber forest product diversification on human development in the Republic of Congo.

Table A1. Results from the short-term model estimation.

```
. vec idh idpfnl lForêtsup CtdEnergiehab services, trend(constant)

Vector error-correction model

Sample:  1987 - 2018                            Number of obs     =        32
                                                AIC               =  -13.86518
Log likelihood =  260.8429                      HQIC              =  -13.27305
Det(Sigma_ml)  =  5.72e-14                      SBIC              =  -12.07882

Equation           Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
D_idh                  7     .005092   0.7321   68.33264   0.0000
D_idpfnl               7     .293215   0.2172   6.934821   0.4357
D_lForêtsup            7     .000345   0.7869   92.32252   0.0000
D_CtdEnergiehab        7     .255855   0.1560   4.619189   0.7063
D_services             7     5.15734   0.2498   8.325187   0.3048
------------------------------------------------------------------
```

Source: Author, based on results from Stata 14.

Table A2. Results from the long-term model estimation.

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
D_idh						
_ce1						
L1.	-.2853476	.0535337	-5.33	0.000	-.3902716	-.1804235
idh						
LD.	.3858884	.1350544	2.86	0.004	.1211866	.6505902
idpfnl						
LD.	-.0021857	.003516	-0.62	0.534	-.0090769	.0047055
lForêtsup						
LD.	9.714742	2.799389	3.47	0.001	4.22804	15.20144
CtdEnergiehab						
LD.	-.0040901	.0048927	-0.84	0.403	-.0136796	.0054993
services						
LD.	.0002869	.0002241	1.28	0.200	-.0001523	.0007261
_cons	-.0075676	.0023213	-3.26	0.001	-.0121172	-.0030179

Source: Author, based on results from Stata 14.