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TESTING THE VALIDITY OF WAGNER'S LAW IN INFLATION TARGETING IN DEVELOPING COUNTRIES

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Abstract

This paper takes into account advanced econometric techniques and tests Wagner's law of long-run relationship between public expenditure and GDP for 17 inflation targeting in developing countries by using the models belong to Peacock and Wiseman (1967) and Gupta (1967) over the period of 1995-2007. According to Peacock and Wiseman (1967)'s model and Gupta (1967)'s model, it is empirically found that there exists strong evidences in support of the validity of the Wagner's law for 17 inflation targeting in developing countries.

Key Words: *Wagner's law, government expenditure, the size of government, panel co-integration*

ENFLASYON HEDEFLEMESİ YAPAN GELİŞMEKTE OLAN ÜLKELERDE WAGNER YASASI'NIN GEÇERLİLİĞİNİN TESTİ

Özet

Bu çalışma gelişmiş ekonometrik teknikleri dikkate alır ve 1995-2007 yılları arası enflasyon hedeflemesi yapan 17 gelişmekte olan ülke için Gayri Safi Milli Hasıla (GSMH) ile Kamu harcamaları arasındaki uzun dönemli ilişkiyi açıklayan Wagner Yasası'nı Peacock-Wiseman (1967) ve Gupta (1967)'ya ait modeller çerçevesinde test etmektedir. Peacock and Wiseman (1967)'nın modeli ile Gupta (1967)'nin modeline göre, enflasyon hedeflemesi yapan gelişmekte olan 17 ülke için

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ampiriksel olarak Wagner Yasası'nın geçerliliğini desteklemede güçlü kanıtlar elde edilmiştir.

***Anahtar Kelimeler**: Wagner Yasası, hükümet harcamaları, hükümetin büyüklüğü, panel eş-bütünleşme*

1. Introduction

The increased role of governments in economic activities depending on increase their expenditures in 19th and 20th century in developing countries has led to focus on studies related to public economics. Public spending figures have showed a steady upward trend in almost all countries. In particular, this figure has been more severe in developed economies than in developing economies. To provide control of increasing of public expenditures is one of the goals of the state. The underlying reason is that the state has been efficient through public expenditures in economy. Therefore, expenditures used by government are considered in order to measure the size of government and the efficiency of government in many empirical studies.

Public services and goods play important role in providing necessary inputs. Public expenditure affects output growth when it affects capital formation or productivity growth. To ensure efficiency and controlled increment of public expenditure have become an important goal.

From the late 1960s the establishment of welfare states induced a rapid increase in the size of governments. The surge in expenditures on public pensions, income support, health care and education lasted at least two decades reaching a peak in the early 1990 in the vast majority of industrialized countries[1]. Therefore, in particular, the long-run relation between government expenditures and economic growth has been a widely area of empirical studies.

The existence of a positive relation between public spending and economic growth was first postulated by the Adolph Wagner in 1911. This is called "law of increasing state activity" maintained that there is both an absolute and a relative expansion of the public sector (including central and local government's bodies and public enterprises), at the cost of the growth in the private sector. Thus, Wagner's law is the statistical evidence of a co-integrating relationship with a positive coefficient. Furthermore, the strict Wagner's law can be evaluated by checking whether the long-run elasticity is significantly larger than one[2].

Wagner (1911) suggests that during industrialization process, the share of government expenditure (both in relative and absolute terms, in total gross national product) increases as the real per capita income of a nation increases. Wagner (1911) predicts that national income causes public expenditure and hence the direction of causality relationship is from GNP to the share of public spending. Moreover, public

[1] Lamartina,S., Zaghini,A. (2008). "Increasing Public Expenditures: Wagner's Law in OECD Countries", **Center for Financial Studies Working Paper** No. 2008/13.

[2] Lamartina,S., Zaghini, A. **Increasing... op.cit.**

spending increases at a faster rate than the growth of national income. This is well-known as "the Wagner's Law". On the contrary, Keynes assumes that public expenditure causes national income and hence, the direction of causality is from public expenditure to GNP as an alternative hypothesis against Wagner's hypothesis. Wagner indicates that public expenditures depend to the changes of the state within economic and social structure with the law.

Table 1. Inflation Targeting in Developing Countries and Year Adopted Inflation Targeting

Country	Year Adopted Inflation Targeting
Chile	1990:Q3
Israel	1992:Q1
Czech Republic	1998:Q1
Korea	1998:Q2
Poland	1998:Q4
Brazil	1999:Q2
Mexico	1999:Q1
Colombia	1999:Q3
South Africa	2000:Q1
Thailand	2000:Q2
Hungary	2001:Q1
Peru	2002:Q1
Philippines	2002:Q1
Romania	2005:Q3
Indonesia	2005:Q3
Slovak Republic	2005
Turkey	2006:Q1

Resource: Yolcu, D. Enflasyon Hedeflemesinin Etkinliği ve Ekonomik Gelişmişlik Arasındaki İlişki. Pamukkale University, The Institute of Social Sciences Master's Thesis, Economics, 2007, Denizli.

At the beginning of 1990s, "Inflation Targeting Discipline" emerged as a new monetary strategy. Inflation targeting policy has been implemented as alternative monetary policy strategy by some countries in order to overcome the severe shocks lived in countries in recent years. However, tight-fiscal policy is essential in order to accomplish inflation targeting. Hence, there is an indirect interaction between monetary and fiscal policies in inflation targeting regime. The presence of strong fiscal policy means that there is no fiscal dominance, which is one of pre-first conditions to carry out inflation targeting regime. The years adopted inflation targeting of these countries are presented in Table 1 above.

This study investigates the validity of Wagner's law for 17 inflation targeting in developing countries over the period of 1995-2007 comprising the years adopted inflation targeting by selected countries. The rest of the paper is following structure: Section 2 reviews the literature related to Wagner's Law. Section 3 details the econometric model used in the study. Section 4 reports empirical results. Section 5 concludes the paper.

2. Literature Review

In this section, the literature will be reviewed about Wagner's law.

Peacock and Wiseman (1961), Goffman (1968), Michas (1975), Pryor (1968), Musgrave (1969) and Mann (1980) are the most important studies that have highlighted the issue by testing the validity of Wagner's law. They use different models to verify the validity of the law. For example, Peacock and Wiseman (1961) use the real public spending and real GDP variables, while Goffman (1968) uses per capita GDP and public spending variables. Michas (1975) asserts that the elasticity of real per capita public expenditure relative to GDP must be bigger than one in order to be valid of the law. We present the six versions widely used in testing Wagner's law in literature[3]:

The (Gupta 1967) model proposes a linear dependence between public expenditure (G) per capita and GDP per capita:

$$\ln\left(\frac{G}{P}\right)_t = \alpha + \beta\left(\frac{GDP}{P}\right)_t + \varepsilon_{1t}$$

Peacock and Wiseman (1967) suggest elasticity of government expenditures relative to GDP is constant as β. The model is defined as follows:

$$\ln G_t = \alpha + \beta.\ln GDP_t + \varepsilon_{2t}$$

The Pryor (1968) model proposes the analysis that comprises private consumption and gross domestic product:

$$\ln C_t = \alpha + \beta.GDP_t + \varepsilon_{3t}$$

[3] Andrei et al. (2009). "Testing Wagner's Law for Romania", **Proceedings of the Challanges for Analysis of the Economy, the Business, and Social Progress, International Scientific Conference**, ISBN 978-963-06-9558-9

The Goffman (1968) model is based on expression of public expenditures with GDP per capita:

$$\ln G_t = \alpha + \beta.(GDP/P)_t + \varepsilon_{4t}$$

The Musgrave (1969) asserts a linear dependence between the share of government expenditures in GDP and GDP per capita:

$$\ln(G/GDP)_t = \alpha + \beta.(GDP/P)_t + \varepsilon_{5t}$$

The last version testing the validity of Wagner law is The Mann (1980)'s model:

$$\ln(G/GDP)_t = \alpha + \beta.(GDP)_t + \varepsilon_{6t}$$

According to Henrekson (1993) the Wagner's law should be interpreted in a relative sense as one of predicting an increasing relative share of public expenditure as per capita real income grows[4].

Yamak and Zengin (2005) estimated the coefficients in the five different specifications in order to examine the validity of Wagner's law using Kalman filter estimation method in Turkey during the period of 1950-1994. Their empirical results strongly confirm Wagner's law for Turkey during the period analyzed since the elasticity of the size of government sector is found to be larger than one or zero in each model specification[5].

Thornton (1999) found unidirectional causality from income to public expenditure. So, the results of Thornton support to Wagner's law for in 19th century for 6 countries. Similarly, Rehman et al. (2010) found that there is a unidirectional causality relation from GDP to government expenditure, which supports the Wagner's Law in Pakistan. However, Cheng and Lai (1997) found bidirectional causality between government expenditure and economic growth in South Korea.

However, there are many contradictory results of study investigating of validity of Wagner's Law. For example Ahsan et al. (1989), Ram (1986), Holmes and Hutton (1990) and Singh and Sahni (1984) prove that public expenditure expansion has significant effect on national income. Similarly, Islam (2001) found strong support for the law for the USA using advanced econometric techniques. On the contrary, Barth, et al. (1990) and Landau (1983) found that public expenditure expansion has negative effect on national income growth for developed and less developed countries[6]. Faris (2002) concluded that a positive relationship between government expenditure and economic growth using a dynamic model.

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[4] Verma, S., Arora R. (2010). "Does the Indian Economy Support Wagner's Law? An Econometric Analysis", **Eurasian Journal of Business and Economics** 3(5),77-91

[5] Yamak, R. Zengin, A. (1997). "Kalman Filtre Yöntemi ve Wagner Yasası: Türkiye Örneği, 1950-1994", The Journal of Economics, Business and Finance, Number:133, Volume:12, pp:32-43.

[6] Rehman, J. (2010)." Cointegration-Causality Analysis between Public Expenditures and Economic Growth in Pakistan", **European Journal of Social Sciences**, 13(4)

Verma and Arora (2010) used six versions including absolute and relative versions to test the validity of Wagner's law. They found that real income elasticities for all the versions are greater than zero. In case of relative versions, their results showed that the elasticities were greater than one which confirms the validity of Wagner's law for India.

Arisoy (2005) investigated to test Wagnerian and Keynesian hypotheses during the period 1950-2003. The empirical findings supported the existence of the long-run relationship between economic growth and disaggregated public expenditure.

Abizadeh and Gray (1985) found support for Wagner's law in the richer countries, but not poorer countries. Chang (2002) found support that Wagner Law is valid for five of the six countries analyzed.

Lamartina and Zaghini (2008) prove a structural positive correlation between public spending and per capita GDP for 23 OECD countries which is consistent with Wagner's Law. Andrei et al. (2010) observe that Wagner's law is valid for aggregate budgetary expenditures for Romania.

3. Data and Methodology used

We used the panel data set. Panel data sets have become increasingly and widely available in developing and developed countries. Panel data sets for economic research have major advantages according as the conventional cross-sectional or time-series data sets. Hsiao listed these advantages of the use of the panel data as follows[7]:

Panel data give the researchers a large number of data, increasing the degrees of freedom, hence improving the efficiency of econometric estimates. Furthermore, panel data allow us to construct and analyze more complicated models than purely cross-sectional or time-series data. The computation and inference done by using panel data analysis can be simplified when compared with the analysis of cross-section data alone or time-series data alone.

There are several models to verify the validity of the Wagner's law in the literature. We used real per capita gross domestic product (LRPGDP), gross domestic product at constant 1990 prices (LGDP), government share of real per capita gross domestic product (LRPGE) and total government expenditure (LGE) as data in this study. All variables are specified in logarithmic form. Data are gathered on yearly basis from 1995 to 2007 of 17 inflation targeting in developing countries. Data are taken from Penn world table 6.3 version. Also in order to carry out the paper E views 6.0 and Gauss 6.0 were applied. We rely on data for the 17 inflation targeting in developing countries: Brazil, Chile, Colombia, Hungary, Indonesia, Israel, Korea, Mexico, Peru, Philippines, Poland, Romania, South Africa, Thailand, Turkey, Czech Republic and Slovak Republic. We also present a series of models used to test Wagner's law. These models are as following: Gupta (1967) and

[7] Hsiao, C. (2003). **Analysis of Panel Data**. Cambridge: Cambridge University Press

Peacock-Wiseman (1967). So, we present a comparative analysis related with these models.

The Gupta's (1967) model proposes a linear dependence between public expenditure (G) per capita and GDP per capita (hereafter Model 1):

$$\ln\left(\frac{G}{P}\right)_t = \alpha + \beta\left(\frac{GDP}{P}\right)_t + \varepsilon_{1t}$$

Peacock and Wiseman (1967) suggest elasticity of government expenditures relative to GDP is constant as β. The model is defined as follows (hereafter Model 2):

$$\ln(G)_t = \alpha + \beta\ln(GDP)_t + \varepsilon_{1t}$$

4. Panel Unit Root Tests and Co-integration Analysis

Panel Unit Root Tests

According to Baltagi and Kao (2000), the power of the panel unit root tests is larger than cross-section data and time series data. Since adding the cross-sectional dimension to time series unit root tests can increase the power of the tests by enhancing the information in the time series.

In order to verify the validity of Wagner's law we must test the stationarity of the data series included in the regression model. In this sense, we use the approaches of Im, Pesaran and Shin (2003) (hereafter IPS), ADF Fisher, Levin, Lin and Chu (2002) (hereafter LLC).

A first generation of models has analyzed the properties of panel-based unit root tests under the assumption that the data is independent and identically distributed (i.i.d) across individuals.

In general, this type of panel unit root tests is based on the following regression:

$$\Delta Y_{i,t} = \beta_i . Y_{i,t-1} + Z_{i,t} . \gamma + u_{i,t} \qquad (1)$$

where i = 1,2,…,N is individual, for each individual

T=1,2,…,T time series observations are available, $Z_{i,t}$ is deterministic component and $u_{i,t}$ is error term. The null hypothesis of this type is ρ_i =0 for $\forall_i$. The first of first generation panel unit root tests is LLC that allow for heterogeneity of individual deterministic effects and heterogeneous serial correlation structure of the error terms assuming homogeneous first order autoregressive parameters. They assume that both N and T tend to infinity but T increase at a faster rate, so N/T $\rightarrow$ 0. They assume that each individual time series contains a unit root against the alternative hypothesis that each time series stationary. Thus, referring to the model (1), LLC assume homogeneous autoregressive coefficients between individual, i.e.

$\beta_i = \beta$ for all I, and test the null hypothesis $H_0 : \beta_i = \beta = 0$ against the alternative $H_A : \beta_i = \beta \prec 0$ for all i. The structure of the LLC analysis may be specified as follows:

$$\Delta Y_{i,t} = \alpha_i + \beta_i . Y_{i,t-1} + \delta_i . \tau + \sum_{j=1}^{p_j} \phi_{ij} . \Delta Y_{i,t-j} + u_{it} \qquad (2)$$

where i = 1,…, N t= 1,…,T τ is trend, α_i is individual effects, u_{it} is assumed to be independently distributed across individuals. LLC estimate to this regression using pooled OLS. In this regression deterministic components are an important source of heterogeneity since the coefficient of the lagged dependent variable is restricted to be homogeneous across all units in the panel[8]. Other test, IPS test allows for residual serial correlation and heterogeneity of the dynamics and error variances across units. Hypothesis of IPS may be specified as follows:

$H_0 : \beta_i = \beta = 0 \quad H_A : \beta_i \prec 0$ for all i

The alternative hypothesis allows that for some (but not all) of individuals series to have unit roots. IPS compute separate unit root tests for the N cross-section units. IPS define their t-bar statistics as a simple average of the individual ADF statistics, t_i, for the null as:

$$\overline{t} = \sum_{i=1}^{N} t_i / N$$

It is assumed that t_i are i.i.d and have finite mean and variance and E(t_i), Var(t_i) is computed using Monte-Carlo simulation technique. Other test Maddala and Wu (1999) consider deficiency of both the LLC and IPS frameworks and offer an alternative testing strategy[9]. MW is based on a combination of the p-values of the test statistics for a unit root in each cross-sectional unit. Im, Pesaran and Shin (2003) (hereafter IPS), ADF Fisher, Levin, Lin and Chu (2002) (hereafter LLC) test have been implemented to check for the existence of unit root in the series.

[8] Barbieri, L. (2008). "Panel Cointegration Tests: A Review". **Rivista Internazionale di Scienze Sociali**, 116.

[9] Barbieri, L. (2008). **Panel... op. cit.**

Table 2. Panel Unit Root Tests for Model 1: 1970-2007

Series	LLC	IPS	ADF
LPGE	-2.213 (0.01)*	1.239 (0.89)	27.788 (0.76)
LPGDP	-0.982 (0.16)	0.265 (0.60)	30.763 (0.62)
DLPGE	-9.487 (0.00)*	-3.869 (0.00)*	81.200 (0.00)*
DLPGDP	-5.870 (0.00)*	-2.481 (0.00)*	62.444 (0.00)*

Note: Probability values are reported in the parentheses. * denotes the rejection of the null at the 5% level. The operator D is difference operator.

The panel unit root tests results of Model 1 are presented in Table 2 above. The presence of unit root in model with trend for LPGDP is confirmed by all tests. It cannot be rejected the null of unit root for LPGE except for LLC test. All tests show that they are stationary variables at 5% level for DLPGE and DLPGDP. Consequently, we can say that these variables are I(1) in their levels.

Table 3. Panel Unit Root Tests for Model 2: 1970-2007

Series	LLC	IPS	ADF
LGE	-0.755 (0.22)	0.550 (0.70)	33.237 (0.50)
LGDP	-0.477 (0.31)	0.695 (0.75)	27.197 (0.78)
DLGE	-9.401 (0.00)*	-3.465 (0.00)*	74.900 (0.00)*
DLGDP	-5.077 (0.00)*	-2.113 (0.01)*	58.031 (0.00)*

Note: Probability values are reported in the parentheses. * denotes the rejection of the null at the 5% level. The operator D is difference operator.

The results of the panel unit root tests that belong to Model 2 are presented above in Table 2. The presence of unit root in model with trend for LGDP is confirmed by all tests at 5% significance level. Similarly, all test results show that it is non-stationary variable at 5% level for LGE. For DLGE and DLGDP, all tests show that they are stationary variables at 5% level. Consequently, all tests conclude that the selected variables are integrated of order one I(1), i.e., the data are non-stationary at levels but stationary after differenced once. Hence, we can investigate for the validity of Wagner's hypothesis.

Analysis of Co-integration

If the presence of a unit root is detected in the variables, then it is necessary to check for the presence of a co-integrating relationship among the variables. This study employs Johansen Fisher panel co-integration test in order to provide evidence for the existence of a long run relationship among series.

Maddala and Wu (1999) use Fisher-type test to propose an alternative approach to testing for co-integration in panel data by combining tests from individual cross-sections to obtain at test statistic for the full panel. Johansen Fisher panel co-integration test combines individual Johansen's co-integration trace tests and maximum eigen value tests. In Johansen's multivariate co-integration technique, trace statistic tests for at most r co-integrating vectors among a system of N>r time series, and the maximal eigen value statistic tests for exactly r co-integrating vectors against the alternative hypothesis of r+1 co-integrating vectors.

Before applying Johansen Fisher panel co-integration test, an optimal lag length for two different panel-based VAR models should be determined; the first one consists of real per capita gross domestic product and government share of real per capita gross domestic product the second one includes gross domestic product and total government expenditure.

Table 4. Johansen-Fisher Panel Co-integration Results for Model 1 (with constant and trend)

Number of Cointegrating Vectors	**Fisher stat. from trace stat.**	**Prob.**	**Fisher stat. from max. eigen test**	**Prob.**
$r \leq 0$	97.00	0.00	93.29	0.00
$r \leq 1$	33.42	0.49	33.42	0.49

Table 4 shows the outcomes of the co-integration test for Model 1. The results indicate that the null hypothesis of no co-integration between LPGE and LPGDP can be rejected at 1% significance level. Carrying out the Johansen-Fisher panel co-integration test showed that there exists at least one co-integrating vector between LPGDP and LPGE for Model 1.

Table 5. Johansen-Fisher Panel Co-integration Results for Model 2 (with constant and trend)

Number of Cointegrating Vectors	**Fisher stat. from trace stat.**	**Prob.**	**Fisher stat. from max. eigen test**	**Prob.**
$r \leq 0$	99.89	0.000	94.98	0.000
$r \leq 1$	35.26	0.408	35.26	0.408

As is seen above Table 5 presents the results of co-integration test for Model 2. The results show that the null hypothesis of no co-integration between LGE and LGDP can be rejected at 1% significance level. The obtained empirical findings indicate that there exist unique co-integrating vectors between LGE and LGDP at 5% significance level.

The Panel Co-integration Estimation

For panel framework, in presence of co-integration to estimate using ordinary least square (OLS) method the long-run equation leads to biased and inconsistent estimator of the parameters. Thus, we use the fully modified ordinary least squares (FMOLS) and dynamic ordinary least squares (DOLS) methodologies developed by Kao and Chiang (2001) to estimate the long-run co-integrating vector of Model 1 and 2. FMOLS estimation corrects the deviations depending on serial correlation and heteroscedasticity[10]. Kao and Chiang (1998) derive limiting distributions for the FMOLS and DOLS estimators in co-integrated regressions and demonstrate that the FMOLS and DOLS estimators are asymptotically normal[11]. According to Mark and Sul (2003) DOLS estimation gives efficient results in small samples (restricted time dimension) and heterogeneous structures.

Panel DOLS estimators corrects endogeneity and autocorrelation problems by using leads and lags of the differenced regressors. Kao and Chiang (2000) reported that DOLS estimator outperformed both OLS and FMOLS estimators in estimating parameter and inference.

Table 6. The Co-integration Coefficients Estimations

	FMOLS			**DOLS**		
	β (st error)	**t-ratio (Prob.)**	**R-square**	β (st error)	**t-ratio (Prob.)**	**R-square**
Model 1	0.7519 (0.0063)	119.27 (0.00)	0.961	0.7355 (0.00756)	97.21 (0.00)	0.967
Model 2	0.9133 (0.011)	79.35 (0.00)	0.826	0.7557 (0.0125)	60.19 (0.00)	0.819

The estimations of the co-integration coefficients are reported in Table 6. As is seen from Table 6, the elasticities of the real GDP in both two models are found to be positive and statistically significant. According to the findings of Model 1, we found that estimates of β are 0.7519 and 0.7355, respectively, using FMOLS and DOLS methods for the period 1995-2007. The coefficients estimated from both FMOLS and DOLS are positively significant at 5% level.

[10] Mark, C., Sul, D. (2003)."Cointegration Vector Estimation by Panel DOLS and Long Run Money Demand". **Oxford Bulletin of Economics and Statisics**, *65*, No. 5, p.657.

[11] Adedeji, O.S. ve Thornton, J. (2007). "Saving, Investment and Capital Mobility in the African Countries". **Journal of African Economies,** 16 (3), 393-405.

According to the estimation results of Model 2, the elasticity of government share with respect to GDP is positive and the coefficient is different from zero at 5% significant level. So, based on these elasticities Wagner's law will not be rejected in selected countries.

5. Conclusion

In this article, we have examined Wagner's law for 17 inflation targeting in developing countries using recent panel data analysis for the period 1995-2007. We used the two models in order to test of the Wagner's hypothesis that increased in GDP causes growth in the government expenditure. The first one is proposed by Gupta (1967). And the second one is asserted by Peacock and Wiseman (1967). For this purpose, firstly we have investigated whether there exists of unit root among the panel series. We find that all variables are I(1), i.e., they are non-stationary variables in level. After obtained findings, we have investigated the presence of long-run relation between considered series. In both models, we accept at least one co-integrating relationship between considered series. According to the results belong to Gupta (1967), the estimated coefficient is 0.7355 as different from zero at 5% significance level.

The empirical results of Peacock and Wiseman (1967)'s model shows that long-term relationship exists between gross domestic product and government expenditure. Finally, we estimated long-run coefficients of co-integrated series using FMOLS and DOLS estimators and we found that estimates of β are 0.9133 and 0.75570, respectively, using the FMOLS and DOLS methods. These results imply that a 1% increase in GDP results in a 0.75–0.92 % increase in government expenditure. An increase in GDP has positive effect on government expenditures. The conclusion that emerges from the empirical analysis from both models is that there exists long-run relationship between the rate of increase in GDP and the rate of increase in public expenditure. Thus, these findings provide strongly empirical support for the existence of Wagner's hypothesis in inflation targeting in developing countries.

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