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► To cite this version:

Fayçal Sawadogo, Abdoul-Akim Wandaogo. Does mobile money services adoption foster intra-African goods trade?. *Economics Letters*, 2021, 199, pp.109681. 10.1016/j.econlet.2020.109681 . hal-03620202

HAL Id: hal-03620202

<https://uca.hal.science/hal-03620202>

Submitted on 25 Mar 2022

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Does mobile money services adoption foster intra-African goods trade?

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Abstract

Using a propensity score matching methodology, we study the causal effect of mobile money services adoption on intra-African goods trade. We find that countries that adopted MM register a higher goods trade share in GDP of about 0.6 percent in comparison to non-adopters.

JEL classification : F10 ; O23 ; O33 ; O55.

Keywords: Mobile money; Goods trade; Impact analysis; Africa.

1. Introduction

Introduced in Africa the first time in Kenya since 2007, Mobile Money (MM) has gradually spread across the continent. In west Africa for example, from 2016 to 2017, the number of MM accounts by 20.9 percent bringing the total accounts number to 104.5 million. The MM is a mobile payment system linked to a phone number and which allows its owners to carry out most of the transactions offered by a traditional bank. MM has then enabled the financial inclusion of a large part of the population rationed by the conventional banking system in countries that have adopted it, while providing them a simple, efficient and accessible means of payment for their business interactions.

From money transfer to bill payment and commerce, MM has become the favorite payment platform for economic agents in many African markets. For example, in 2011, there was 13 times more active mobile financial services agents than automatic machine teller machines in Kenya (Jack, W., & Suri, T., 2014). Several studies have thus shown that MM promotes financial inclusion and financial development (Burns, S. (2015), Asongu, S. A. (2013), Donovan, K. (2012). Therefore, financial development is international trade increase factor. Furthermore, the flexibility and availability MM offers had contributed to make it transcend national borders with possibilities for inter-operator and international transactions with enterprises from micro to medium-sized. However, no empirical studies have so far addressed the role of MM in increasing intra-African trade. With this in mind, we investigate the causal effect of MM adoption on the intensity of intra-African trade. This study, using a propensity score matching method (PSM), suggests that the adoption of MM services has led to increased intra-African trade. This causal effect is more important for all food items goods category.

2. Data and identification strategy

This study aims to investigate the causal effect of MM adoption on intra-African goods trade considering panel data on 48 African countries from 1995 to 2018. Our main explanatory variable is therefore MM which is a dummy variable taking value 1 if at least one mobile service is available and 0 otherwise.¹ Our dependent variables are goods trade in share of GDP and its breakdown into imports and exports², extracted from UNCTAD statistics. Based on the literature, we select a set of control variables (Gnangnon, S. K., & Iyer, H. 2018, Nath, H. K., & Liu, L. 2017, Choi, C. 2010). We use several variables that could affect both mobile money services adoption and trade to control for income effects, country size, and macroeconomic effects. Appendix 1 presents variables definitions and sources and table 1 provides descriptive statistics of the data.

To address the issue of the causal effect of MM adoption on intra-African trade, we follow Sawadogo, P. N. (2020), Girma, S. et al. (2003), and Wagner, J. (2002) using a propensity score-matching (PSM) method (Rosenbaum and Rubin, 1983) which is suitable for observational studies (non-randomized) as it permits correction for sample selection bias due to observable differences between the treatment and the control groups. PSM works in two steps. In a first step, using a probit approach, we estimate propensity score (PS) which is the probability $e(y_i)$ for a country i to adopt MM giving a set of covariates also affecting MM and trade variables :

$$e(y_i) = P(MM_i = 1/y_i) \quad (I)$$

In a second step, we estimated the Average Treatment effect on the Treated (ATT) which is the average difference between the trade share in GDP in countries with MM (TD^1) and the trade share in GDP they would have in non-MM adoption situation (TD^0). We can then write it mathematically as following:

$$ATT = E[(TD_i^1 - TD_i^0)/MM_i = 1] \quad (II)$$

Developing equation II, we have:

$$ATT = E(TD_i^1/MM_i = 1) - E(TD_i^0/MM_i = 1) \quad (III)$$

In fact, the second term of (II) is not observable. We then replace it by TD in countries that have not adopted MM but have comparable basic characteristics (Y) than MM services adopters. This is because the adoption of MM is correlated with a set of basic characteristics Y that can affect the level of trade. However, following Rosenbaum and Rubin (1983), we concentrate information from Y in a unique variable $e(y_i)$ estimated in the first step (PS). We can therefore rewrite the ATT as below:

$$ATT = E[TD_i^1/MM_i = 1, e(y_i)] - E[TD_i^0/MM_i = 0, e(y_i)] \quad (IV)$$

We then estimate the ATT using four matching methods. We first consider **nearest neighbor matching** which matches each MM adopter with the non-adopter with closest PS (we consider $n=1, 2$, and 3). We also consider **radius matching** which retain non-adopters having a PS comprises in a radius (we consider $r=0.005$, $r=0.01$, and $r=0.05$). **Kernel estimator** which consists to match each MM adopter with a weighted average of all non-adopters is also used to estimate the ATT. Finally, we perform a **local linear regression** which improves kernel estimator by including a linear term in the weighting function (Fan, 1992, 1993).

¹ We construct it using information from [GSM](#).

² We consider them in logarithm for interpretation purpose.

Table 1: Descriptive statistics

Variables	Obs.	Mean	Std. Dev.	Min	Max
Log(Total Goods Trade/GDP)	1,182	-4.923	1.031	-8.044	-2.233
Log(Goods Imports/GDP)	1,182	-10.03	1.166	-13.42	-6.984
Log(Goods Exports/GDP)	1,182	-10.88	1.383	-16.12	-7.697
Mobile Money	1,224	0.279	0.449	0	1
Log(Population)	1,217	15.89	1.473	11.79	19.09
Log(GDP per capita)	1,155	7.095	0.990	5.212	9.930
Financial depth	1,060	19.65	23.40	0.403	160.1
Inflation	1,038	9.962	32.91	-60.50	541.9
Total natural resources rents	1,178	12.99	12.74	0.0342	84.23
Fix regime	1,224	0.409	0.492	0	1

3. Empirical results

3.1. Propensity scores estimates

Table 2 presents the results of the PS estimates. Our results show that population, financial depth, and fix regime exchange rate are positively affecting MM adoption and are significant at least at 10% level. We find that Log(GDP per capita) effect on MM adoption is negative but is not significant. Worse macroeconomic situations measured by the inflation rate is negatively affecting MM adoption and its coefficient is significant at 1 percent level. We find that natural resources rents coefficient is not significant.

Table 2: Propensity scores probit estimation results

	Mobile Money
Log(Population)	0.2454*** (0.0369)
Log(GDP per capita)	-0.0606 (0.0564)
Financial depth	0.0067*** (0.0022)
Inflation	-0.0191*** (0.0064)
Natural resources rents	-0.0015 (0.0040)
Fix regime	0.2094* (0.1082)
Constant	-4.0268*** (0.7765)
Observations/Pseudo-R2	907/0.08

Note: standard errors in brackets.*** significance level at 1 percent; ** significance level at 5 percent;

3.2. Results of matching on propensity scores

Matching results are presented in tables 3 to 5. We report the ATT on goods trade share in GDP. We also check the quality of our estimations by running some diagnostic tests. First, the pseudo-R2 analyses how well our control variables explain the probability of adopting MM (Sianesi, 2004). Caliendo and Kopeinig (2008) argues that a good model performance should be associated to a “fairly low” value (all pseudo-R2 here are lower than 0.01). Furthermore, we check the conditional independence assumption regarding both observables and unobservables (Rosenbaum, 2002). On observables side, the standardized bias test which evaluates the marginal distance distributions of the retained control variables reveals the absence of no statistical difference between MM adopters’ characteristics and non-adopters’ after matching. Concerning

unobservables, we report the Rosembaum (2002) lower bound sensitivity test³ which analyses if there are no unobservables that could affect the effect of MM adoption on goods trade.

Table 3 shows the main results. Independently of the matching method, we observe that all estimated ATT are positive and significant at 1 percent level. They range between 0.5268 (radius $r=0.05$) and 0.6259 (neighbor $n=2$) representing between 51 percent and 61 percent of Log(Total goods trade/GDP) standard deviation (corresponding to 1.031 in table 1); therefore, making these results economically meaningful. On average, countries that adopt MM services, experience higher goods trade share in GDP of about 0.6 percent.

We also investigate the effect of MM adoption on both aggregated goods imports and exports. Tables 5 and 6 show the results. The ATT is respectively 0.68 percent and 0.56 percent on average for respectively imports and exports, showing that MM adoption effect on goods trade is higher on imports than exports. Furthermore, we find that MM adoption benefits more to food item trade. We do not find any significant effect on agricultural raw materials trade. However, the effect on their imports and exports taken separately is significant but is less than that of primary commodities and food items.

Table 3: Matching results for Log(Total goods trade/GDP)

Treatment variable: Mobile Money	1-Nearest	2-Nearest	3-Nearest	Radius Matching			Local Linear	Kernel
	Neighbor	Neighbor	Neighbor	r=0.005	r=0.01	r=0.05	Regression	
	Matching	Matching	Matching				Matching	
Dependent variable: Log(Total Goods trade/ GDP)								
Average Treatment on the Treated (ATT)	0.6162*** (0.1125)	0.6259*** (0.1103)	0.6121*** (0.1013)	0.6165*** (0.0903)	0.6047*** (0.0833)	0.5268*** (0.0668)	0.6025*** (0.0686)	0.5324*** (0.0677)
Observations/Treated observations	907/301							
Quality of the matching								
Pseudo-R2	0.007	0.009	0.009	0.009	0.007	0.003	0.007	0.003
Rosenbaum bounds sensitivity test	2.3	2.9	3.3	3.6	3.6	3.4	4.3	3.4
Standardized bias (p-value)	0.415	0.299	0.284	0.306	0.47	0.876	0.415	0.875
ATT by type of goods								
Agricultural raw materials	0.1724 (0.1787)	0.1091 (0.1677)	0.0829 (0.1677)	0.1195 (0.1402)	0.0868 (0.1365)	-0.0181 (0.0994)	0.0751 (0.1063)	-0.0112 (0.1039)
Primary commodities excluding fuels	0.5560*** (0.1476)	0.5795*** (0.1245)	0.6211*** (0.1216)	0.5817*** (0.1118)	0.5925*** (0.0999)	0.5017*** (0.0779)	0.5881*** (0.0804)	0.5109*** (0.0809)
All food items	0.6194*** (0.1306)	0.6636*** (0.1275)	0.7013*** (0.1209)	0.6444*** (0.1145)	0.6608*** (0.1008)	0.5638*** (0.0770)	0.6633*** (0.0761)	0.5735*** (0.0784)

Standard errors in brackets. *** significance level at 1%, ** significance level at 5%, * significance level at 10%. Bootstrap replications=500

³ The test is conducted at 5 percent level.

Table 4: Matching results for $\text{Log}(\text{Total goods imports}/\text{GDP})$

Treatment variable: Mobile Money	1-Nearest	2-Nearest	3-Nearest	Radius Matching			Local Linear	Kernel
	Neighbor	Neighbor	Neighbor				Regression	
	Matching	Matching	Matching	r=0.005	r=0.01	r=0.05	Matching	
Dependent variable: Log(Goods Imports/ GDP)								
Average Treatment on the Treated (ATT)	0.7143*** (0.1397)	0.7251*** (0.1277)	0.7170*** (0.1223)	0.7116*** (0.1135)	0.7030*** (0.1031)	0.5924*** (0.0739)	0.6639*** (0.0748)	0.6026*** (0.0778)
Observations/Treated observations	907/301							
Quality of the matching								
Pseudo-R2	0.007	0.009	0.009	0.009	0.007	0.003	0.007	0.003
Rosenbaum bounds sensitivity test	2.4	3	3.3	3.5	3.6	3.3	3.9	3.4
Standardized bias (p-value)	0.415	0.299	0.284	0.306	0.47	0.876	0.415	0.875
ATT by type of goods								
Agricultural raw materials	0.2279 (0.1681)	0.2434 (0.1530)	0.3159** (0.1341)	0.3046** (0.1228)	0.3088*** (0.1076)	0.2267*** (0.0852)	0.3017*** (0.0836)	0.2333** (0.0934)
Primary commodities excluding fuels	0.5220*** (0.1171)	0.5580*** (0.1196)	0.5670*** (0.1041)	0.5566*** (0.0977)	0.5541*** (0.0924)	0.4687*** (0.0747)	0.5411*** (0.0768)	0.4769*** (0.0760)
All food items	0.6514*** (0.1255)	0.6677*** (0.1190)	0.6789*** (0.1110)	0.6532*** (0.1061)	0.6714*** (0.0997)	0.5738*** (0.0732)	0.6606*** (0.0752)	0.5836*** (0.0774)
Standard errors in brackets. *** significance level at 1%, ** significance level at 5%, * significance level at 10%. Bootstrap replications=500								

Standard errors in brackets. *** significance level at 1%, ** significance level at 5%, * significance level at 10%. Bootstrap replications=500

Table 5: Matching results for $\text{Log}(\text{Total goods exports}/\text{GDP})$

Treatment variable: Mobile Money	1-Nearest	2-Nearest	3-Nearest	Radius Matching			Local Linear	Kernel
	Neighbor	Neighbor	Neighbor	r=0.005	r=0.01	r=0.05	Regression	
	Matching	Matching	Matching				Matching	Matching
Dependent variable: Log(Goods Exports/ GDP)								
Average Treatment on the Treated (ATT)	0.5230*** (0.1408)	0.5672*** (0.1263)	0.5756*** (0.1282)	0.5742*** (0.1159)	0.5627*** (0.1046)	0.5283*** (0.0870)	0.6024*** (0.0863)	0.5283*** (0.0803)
Observations/Treated observations	907/301							
Quality of the matching								
Pseudo-R2	0.007	0.009	0.009	0.009	0.007	0.003	0.007	0.003
Rosenbaum bounds sensitivity test	1.8	2.4	2.7	2.9	2.9	2.9	3.5	2.9
Standardized bias (p-value)	0.415	0.299	0.284	0.306	0.47	0.876	0.415	0.875
ATT by type of goods								
Agricultural raw materials	0.5811* (0.2978)	0.5321** (0.2540)	0.3591 (0.2528)	0.4276* (0.2196)	0.3633* (0.2093)	0.2634* (0.1573)	0.3756** (0.1535)	0.2698 (0.1660)
Primary commodities excluding fuels	0.6537*** (0.2052)	0.6807*** (0.1877)	0.7806*** (0.1801)	0.7228*** (0.1474)	0.7323*** (0.1592)	0.6417*** (0.1101)	0.7523*** (0.1208)	0.6504*** (0.1108)
All food items	0.7592*** (0.2220)	0.8297*** (0.2145)	0.9078*** (0.1859)	0.8146*** (0.1726)	0.8046*** (0.1629)	0.7292*** (0.1273)	0.8437*** (0.1257)	0.7362*** (0.1219)
Standard errors in brackets. *** significance level at 1%, ** significance level at 5%, * significance level at 10%. Bootstrap replications=500								

Standard errors in brackets. *** significance level at 1%, ** significance level at 5%, * significance level at 10%. Bootstrap replications=500

We are assuming here that MM adoption is causing an increase in trade share in GDP. Nonetheless, the magnitude of the volume of trade could also lead to the need of alternative payments solutions, thus being able to influence mobile money adoption. We therefore estimate a panel two step system GMM (Blundell and Bond, 1998) to take into account any potential endogeneity as Choi, C. (2010). To overcome the proliferation of instruments, we restrict and collapse the set of instruments (Roodman, 2009) and we use Windmeijer (2005) standard errors in order to correct the finite sample bias. The AR(2) and Hansen tests p-values support the validity of our models. Table 6 presents the results. The estimated coefficients of MM are significant at 1 percent level and respectively equal to 0.59, 0.52, and 0.6 for the specification with $\text{Log}(\text{Total trade}/\text{GDP})$, $\text{Log}(\text{Exports}/\text{GDP})$, and $\text{Log}(\text{Imports}/\text{GDP})$ respectively; and comparable to those estimated in tables 3, 4, and 5.

Table 6: Mobile money adoption and Goods trade: panel two step system GMM.

	Log (Total trade/GDP)	Log (Exports/GDP)	Log (Imports/GDP)
	(1)	(2)	(3)
Mobile Money	0.592*** (0.1676)	0.520*** (0.1756)	0.597*** (0.1498)
Log(Population)	-0.262* (0.1536)	0.126 (0.1794)	-0.390*** (0.1411)
Log(GDP per capita)	-0.225 (0.3960)	-0.144 (0.5243)	-0.186 (0.4297)
Financial depth	0.000 (0.0178)	0.008 (0.0118)	-0.008 (0.0167)
Inflation	-0.002 (0.0010)	-0.003* (0.0015)	-0.001 (0.0010)
Natural resources rents	0.006 (0.0072)	0.014* (0.0083)	0.007 (0.0089)
Fix regime	0.173 (0.3093)	0.408 (0.3810)	0.055 (0.3260)
Constant	0.565 (4.4082)	-12.427*** (4.7513)	-2.575 (4.5040)
Observations	876	876	876
Groups	48	48	48
Instruments	18	18	18
AR1-pvalue	0.00	0.00	0.01
AR2-pvalue	0.93	0.13	0.90
Hansen-pvalue	0.29	0.65	0.36

Note: Robust standard errors in brackets.*** significance level at 1 percent; ** significance level at 5 percent; * significance level at 10 percent.

Included instruments are (Mobile Money)t-1, (Mobile Money)t-2, Log(GDP per capita)t-1, Log(GDP per capita)t-2, (Financial depth)t-1, (Financial depth)t-2, (Natural resources rents)t-1, (Natural resources rents)t-2, Log(Population)t-1, (Inflation)t-1, (Fix regime)t-1.

4. Conclusion

Using trade data on 48 African countries and a PSM methodology, we investigate the causal effect of adopting MM services on intra-African goods trade. We find that countries that adopted MM register a higher goods trade share in GDP of about 0.6 percent in comparison to non-adopters. Furthermore, we find that this positive effect is higher for food items. Adopting MM services then have positive effects on intra-African trade as it facilitates money payments and transfers.

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Appendix : Variables definition

Variables	Définitions	Sources
Mobile Money	Mobile money is a dummy variables taking 1 if a mobile money service is adopted in te country and 0 if not	Authors construction using information from Global System for Mobile Communications Association (GSMA)
Agricultural raw materials (% GDP)	Total import and export of agricultural raw materials in percentage of GDP	United Nations Conference on Trade and Development (UNCTAD) statistics
Goods trade (% GDP)	Total import and export of all product in percentage of GDP excluding services	UNCTAD
Foods items (% GDP)	Total import and export of foods items in percentage of GDP including tea, coffee, cocoa and spices	UNCTAD
Primary commodities excluding fuels (% GDP)	Import and export of primary commodities excluding fuel in percentage of GDP	UNCTAD
Financial Deph	Domestic credit to private sector in percentage of GDP	World Development Indicators (WDI)
GDP per capita	Per capita gross domestic product constant 2010 US dollar	WDI
Inflation, consumer prices (annual %)	Annual percentage change in the cost to the average consumer of acquiring a basket of goods and services.	WDI
Total natural ressource (% GDP)	sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents.	WDI
Total Population	Total population	WDI
Fixed regime	Fixed regime is a dummy variable taking 1 if country adopted fixed regime and zero if not	Authors construction using Internatiional Monetary Fund exchange rates classification