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To cite this article: Saten Kumar (2014) Money demand income elasticity in advanced and developing countries: new evidence from meta-analysis, Applied Economics, 46:16, 1873-1882, DOI: [10.1080/00036846.2014.887195](https://doi.org/10.1080/00036846.2014.887195)

To link to this article: <https://doi.org/10.1080/00036846.2014.887195>



Published online: 26 Feb 2014.



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Money demand income elasticity in advanced and developing countries: new evidence from meta-analysis

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This article extends the meta-analysis presented in Knell and Stix (2005, 2006) to investigate the possible sources of variations in empirical findings about the income elasticity of money demand in advanced and developing countries. In the case of advanced countries, we find that the income elasticities of money demand are significantly higher if broader definitions of the monetary aggregates are used. In addition, financial reforms and wealth seem to have significantly reduced the estimates of the income elasticity. However, we achieved quite different findings for the developing countries. It appears that the broader definitions of monetary aggregates seem to produce income elasticity estimates that are only marginally higher than the narrower aggregates. While the wealth (financial reform) impacts on income elasticity are statistically insignificant (weakly significant), both seems to have reduced the income elasticity estimates only marginally. Moreover, some contrasting results between advanced and developing countries are also attained with respect to the proxies of cost of holding money.

Keywords: demand for money; income elasticity; meta-analysis

JEL Classification: E40; E41

I. Introduction

This article extends the meta-analysis presented in Knell and Stix (2005, 2006) to investigate the possible sources of variations in empirical findings about the income elasticity of money demand in advanced and developing countries. Knell and Stix (2005) selected 79 articles from the EconLit database published after 1994, and these studies largely focused on the European countries. In another paper, Knell and Stix (2006) performed meta-analysis for almost 1000 estimations taken from three different samples, viz., Knell and Stix (2003), Sriram (2001) and Fase (1993). While Knell and Stix (2006) did examine some study characteristics for the non-OECD countries, however their sample includes relatively less number of studies from the developing countries. The

sample in Fase (1993) contains no studies on the developing countries. Sriram's (2001) sample includes studies published mainly during the 1990s, thus ignoring all those published prior to the 1990s and also those published in the post-2000 period. Further, only 22% of the total observations were based on the non-OECD countries in Knell and Stix (2003). To this end, the value added of this article is that it includes more recent contributions including a large proportion of developing country estimates; the significance of this is detailed in the data section below.

Given that the recent contributions on money demand have focused on the developing countries, it is therefore vital to include these studies in meta-analysis. Since the income elasticity estimates of *MI* (narrow money) demand signify the development of the financial markets

(see Rao *et al.*, 2009a, b), it is logical to assume that the income elasticity estimates in the advanced countries to be lower than the developing countries. Since the financial market institutions and their characteristics are slightly different among advanced and developing countries (e.g. wide use of narrow money (notes and coins) in the developing countries while in the advanced countries broader forms of money (credit and debit cards) is more common), it is therefore feasible to perform meta-analysis for the two samples separately. Our results show that variations in the income elasticity due to study characteristics differ for the advanced and developing countries. This implies that there exist considerable disparities in the estimates of money demand between advanced and developing countries.

The outline of this article is as follows: Section II provides a brief description of the data. Section III provides an overview of income elasticity of the demand for money, and Section IV details the empirical results attained from meta-regression analysis. Finally, Section V concludes.

II. Data

The initial stage in meta-analysis is to search and select relevant studies, and the selection criteria are vital to avoid selection and availability biases. We selected studies from the EconLit and Research Papers in Economics (RePec) databases. Basically, the selected studies fulfilled the following two criteria: (a) the title contains either 'money demand' or 'monetary policy' or 'financial reforms/innovations' or 'currency substitution' and (b) the article is dated in the post-1980 period. The list of studies used in meta-analysis can be obtained from the authors upon request. Table 1 provides details of the variables used in the meta-analysis.

Table 2 displays the descriptive statistics of the two samples, viz., advanced and developing countries. We used 137 articles covering 27 advanced countries. For the developing countries, 140 articles were selected covering 44 countries. For each of these articles, we extracted information about their estimated income elasticities, monetary aggregates, explanatory variables, methods employed and data. The descriptive statistics show that the mean of income elasticities in advanced and developing countries, respectively, are 0.90 and 1.09. These average income elasticities are close to unity, consistent with the quantity theory of demand for money. At the same time, the SDs, respectively, are 0.34 and 0.42, indicating considerable variation in the estimated income elasticities. Further, the average income elasticities are slightly different when we split the sample into estimations that use narrow money and those that use broad money. For advanced countries, the average income elasticities (with

Table 1. Meta-independent variables

	= the point estimates of long-run income elasticities
<i>Monetary aggregates</i>	
<i>M1</i>	1 if a study uses <i>M1</i>
<i>M2</i>	1 if a study uses <i>M2</i>
<i>M3</i>	1 if a study uses <i>M3</i>
Narrow money	1 if a study uses <i>M0</i> or <i>M1</i>
Broad money	1 if a study uses <i>M2</i> or <i>M3</i>
<i>Other variables</i>	
Wealth	1 if a study includes a measure of wealth
Inflation rate	1 if a study uses a measure of inflation rate
Exchange rate	1 if a study uses a measure of exchange rate
Financial reform	1 if a study includes a measure of financial reform
Interest rate	1 if a study uses a measure of interest rate
Multivariate	1 if a study uses multivariate cointegration technique
Single equation	1 if a study uses single-equation cointegration technique
Stability tests	1 if a study includes parameter stability tests
Number of observations	The number of observations of individual samples
Number of years	The number of years in the sample used for estimating income elasticities
Precision	The <i>t</i> -statistic of the estimated income elasticity

Notes: Most studies measured financial reforms by constructing dummy variables. For example, if Australia implemented significant financial reforms from the period 1980 to 1985, then usually authors construct the financial reforms dummy as 1 from 1980 to 1985 and 0 otherwise.

Table 2. Descriptive statistics

	Advanced countries sample	Developing countries sample
Number of observations	251	268
Number of studies	137	140
Number of different countries	27	44
Narrow money	95	104
Broad money	156	135
Wealth	25	14
Interest rate	232	217
Price or inflation rate	94	53
Exchange rate	41	34
Financial reforms	30	22
Multivariate	153	144
Single equation	98	124
Stability tests	205	192
Average income elasticity	0.90 (0.34)	1.09 (0.42)
Average income elasticity: narrow money	0.81 (0.36)	1.08 (0.43)
Average income elasticity: broad money	1.15 (0.37)	1.12 (0.36)

Notes: Advanced and developing country samples, respectively, include 32 and 18 multicountry studies. SDs are given in the parentheses.

SDs in parentheses) for estimations that use narrow money and broad money, respectively, are 0.81 (0.36) and 1.15 (0.37). On the other hand, for the developing countries the average income elasticities with corresponding SDs in parentheses, respectively, for narrow and broad money measures are 1.08 (0.43) and 1.12 (0.36).

Knell and Stix (2006) found the following average income elasticities: 0.79 (OECD, narrow money), 1.12 (OECD, broad money), 0.89 (non-OECD, narrow money) and 0.96 (non-OECD, broad money).¹ Our average income elasticities for the advanced countries are fairly consistent with them; however, somewhat different averages are attained for the developing countries perhaps due to updated data. Note that our developing countries sample includes more recent contributions. Two useful features emerge from our results. First, narrow monetary aggregates yield lower income elasticity estimates in the advanced countries than for the developing countries. This is not unexpected because financial systems in the advanced countries are relatively well developed and efficient. Second, broad monetary aggregates produce high-income elasticity estimates in the advanced countries than for the developing countries. This implies that the aggregate portfolio decisions that influence money demand behaviour is more relevant for the advanced countries.

III. Income Elasticity of Money Demand

Since real income is the scale variable in money demand specifications and its magnitude (income elasticity) provides useful insights on the development of the financial

market, it is therefore vital that this parameter is estimated precisely. Figure 1 illustrates the point income elasticity estimates for advanced and developing countries. It is well known that outliers in the sample will bias the average estimates and it is therefore important to deal with this issue. To avoid estimation bias (outliers), we selected estimations that fall in the range $0.3 \leq \text{income elasticity} \leq 2.0$. Using this criterion, we selected income elasticities that were statistically significant. To this end, the total number of observations is 251 (268) for the advanced (developing) countries.

It is logical to assume that the income elasticity of money demand in the advanced countries to be different than the developing countries. Since the advanced countries have well-developed financial systems, a lower income elasticity of *M1* (narrow money) demand is feasible. Moreover, it is plausible that the broader measures of money (e.g. *M2*, *M3* and *M4*) may produce slightly higher estimates of the income or wealth elasticity than the *M1* aggregate. This is pragmatic because as income grows individuals will economize more on cash (i.e. narrow money) and substitute with the check/savings accounts (i.e. broader aggregates). Higher income elasticity of broad money is justified on the basis of portfolio decisions that influence the money demand behaviour. However, this inference should be interpreted cautiously because growth in income may be lower in the developing countries and as a result their substitution effects may be minimal. Higher substitution effects may be observed in the advanced countries. Rao and Kumar (2009a, b) argued that the income elasticity is expected to be lower (around or slightly higher) than unity in the advanced (developing)

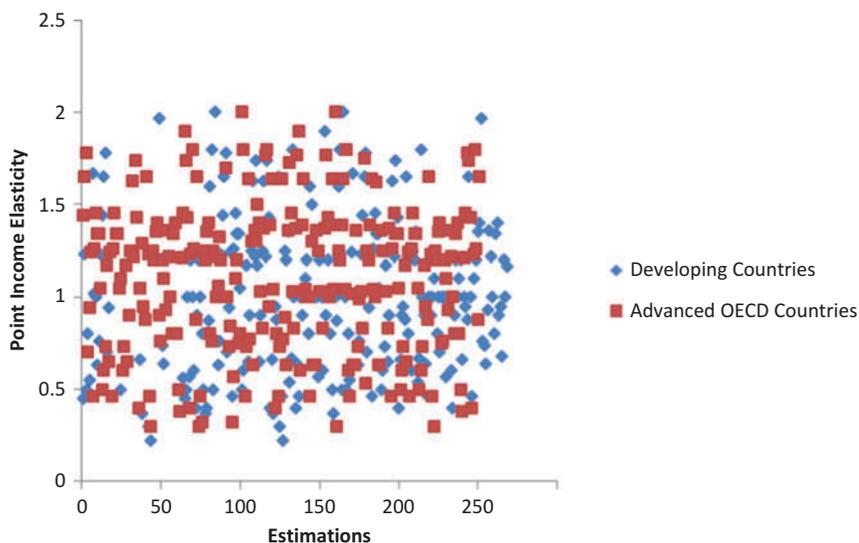


Fig. 1. Estimates of income elasticity in the advanced and developing countries

¹ These estimates are from their Knell and Stix (2003) sample.

countries. Ball (2001) pointed out that low-income elasticity estimates would imply that the Friedman rule is not optimal and that the money supply should grow more sluggishly than income to attain price stability.

Following the financial reforms and liberalization policies of the mid-1980s, it is reasonable to assume that the *M1* demand elasticity with respect to income may have declined and the rate of interest elasticity may have increased in absolute value. Financial reforms refer to the change in the financial system so that it operates in a more effective way. It may lead to improvement in the efficiency of the banks. There is no doubt that advanced countries have diversified financial sector instruments and offer more opportunities to improve savings and efficiency. There are also more nonbank financial institutions with established track record. Such diversification in the financial system ensures that capital is mobilized from several avenues than from the traditional banking sector. In light of these observations, it could be argued that the income elasticity of *M1* demand in the advanced countries is expected to be much lower than unity, consistent with the Baumol–Tobin model. To this end, it naturally reflects their better financial system in which economies of scale in the money demand reduce the cost of transactions and also reduce the use of liquid assets such as *M1*. The same may be observed for transitional economies; however, it depends on the extent of financial development that has been achieved through the implementation of financial liberalization policies in such countries.

On the other hand, most developing countries generally lack the features like diversified financial sector and instruments, and payments technology. It is therefore pragmatic to assume that income elasticity in the developing countries is around unity (or slightly above). Such income elasticity would imply underdeveloped financial markets where most transactions involve the use of narrow money as opposed to other forms of monetary aggregates. To this end, it is likely that the quantity theory of money may hold for majority of the developing countries.

IV. Empirical Results

Monetary aggregates and wealth

The benchmark meta-regressions are employed to analyse whether the variation in income elasticities can be attributed to wealth and various forms of monetary aggregates. In doing so, the point estimates of income elasticities are regressed on independent variables, i.e. monetary aggregates and wealth. The results for advanced and developing countries are summarized in Table 3.

Knell and Stix (2005) observed that the inclusion of country-specific dummies seems to make non-negligible

Table 3. Income elasticity responses to monetary aggregates and wealth

Dependent variable: income elasticity				
Variables	Advanced countries		Developing countries	
	(1)	(2)	(3)	(4)
<i>M1</i>	0.103 (2.64)*		0.014 (1.75)**	
<i>M2</i>	0.301 (1.72)**		0.089 (2.67)*	
<i>M3</i>	0.365 (2.26)*		0.018 (2.04)*	
Broad money		0.287 (2.27)*		0.019 (3.37)*
Wealth	-0.153 (2.02)*	-0.148 (2.18)*	-0.007 (1.26)	-0.004 (1.48)
Intercept	2.220 (5.61)*	1.057 (6.94)*	0.913 (6.82)*	2.110 (4.15)*
Number of observations	251	251	268	268
R^2	0.38	0.36	0.36	0.34

Notes: The absolute *t*-ratios are given in the parentheses.

* and ** denote significance at 5% and 10% levels, respectively.

differences in the results. Therefore, for sake of robustness in the results, we include country-specific dummies in most regressions. Columns 1 and 3 report the results of specifications with wealth and monetary aggregates ranging from *M1* to *M3*. In columns 2 and 4, the explanatory variables are wealth and broad money (*M2* and *M3* combined). Studies that utilized the measures of wealth found significant impact of wealth on the demand for money, particularly associated with reduced income elasticity. The demand for money depends on all types of wealth and is supported by the groundbreaking works of Friedman (1954) and Keynes (1936). To this end, the use of the wealth dummy is justified.

All the estimated coefficients have the expected signs and are statistically significant at the conventional levels, except the estimates of wealth dummy in the developing countries sample. Results for the advanced countries sample reveal that the income elasticity is high when broader measures of monetary aggregates are used. To this end, the income elasticity of *M2* and *M3* may be significantly higher than *M1*. However, this is not the outcome in the developing countries sample. In the case of developing countries, income elasticity of broader aggregates seems to be only marginally higher than the narrower aggregates. This result is reasonable because substitution effects (portfolio decisions) seem to be limited in the developing countries because growth in income is low. Moreover, the results suggest that inclusion of wealth significantly reduces the income elasticity estimates in the advanced countries; however, wealth estimates are statistically insignificant in the developing countries. There are two

implications of this finding. First, since the per capita wealth in the developing countries is low, it is plausible that wealth effects on income elasticity may be minimal. Second, wealth estimates are statistically insignificant possibly because less number of studies on the developing countries employed wealth as an explanatory variable (see Table 2).

Overall, with this small set of independent variables, the benchmark meta-regressions can only explain about 34–38% of variation in income elasticities in advanced and developing countries sample. Note that low r^2 is not uncommon in estimations that involve dummy variable regressors. However, when these income elasticity regressions were tested for temporal stability, the CUSUM and CUSUMSQ tests revealed that they are largely stable (see Figs A1 and A2 in the ‘Appendix’ section).²

Financial reforms and income elasticity

Most advanced countries liberalized their financial markets during the 1960s and 1970s while most developing countries were late starters and delayed reforms until the late 1980s. A number of studies in the demand for money literature have used proxies to capture the impacts of financial reforms and innovations on the money demand. It is likely that the financial sector reforms encouraged economies of scale in the money demand, thus lowering the income elasticity. To this end, we include a dummy variable indicating whether a study contains a measure of financial reforms. Table 4 reports the estimates of financial reforms and broad money for advanced and developing countries.

When income elasticity was regressed on only the reforms dummy, the dummy estimates were statistically insignificant at the conventional levels. Including wealth and $M1$ in the regressions did not yield any robust estimates. However, meaningful estimates were attained when both broad money and reforms dummies were regressors in the equation. For the advanced (developing) countries, the reforms dummy is significant at the 5% (10%) significance level and in both cases it has the expected negative sign. Some interesting implications emerge from the estimates of the reforms dummy. It is observed that reforms had a significantly higher impact on the income elasticity of the advanced countries. This implies that financial markets are well developed in the advanced countries and there exists efficiency and economies of scale in the demand for money. Though most of the developing countries also implemented significant reforms during the 1980s and 1990s, it could be that reforms are yet to have significant impacts on the economy or adequacy of such reforms is yet to be considered.

Table 4. Income elasticity response to financial reforms

Dependent variable: income elasticity		
Variables	Advanced countries	Developing countries
Broad money	0.299 (1.73)**	0.025 (1.83)**
Financial Reforms	-0.134 (2.12)*	-0.042 (1.69)**
Intercept	0.878 (5.70)*	1.319 (2.70)*
Number of observations	251	268
R^2	0.35	0.34

Notes: The absolute t -ratios are given in the parentheses. * and ** denote significance at 5% and 10% levels, respectively.

Application of the CUSUM and CUSUMSQ tests indicated that the estimated income elasticity equations are stable (see Figs A1 and A2 in the appendix).³

Opportunity costs of money

Almost all individual studies use proxies to capture the true cost of holding money. Knell and Stix (2005, 2006) have explored the possible impacts of interest and inflation rates on the income elasticities, but they ignored to include the exchange rate. We collected 41 and 34 estimations, respectively, for advanced and developing countries that include exchange rate as a proxy for cost of holding money (see Table 2).

We investigate how the variability in income elasticity estimates in the advanced and developing countries sample is attributed to the various costs of holding money variables (rate of interest, inflation rate and exchange rate). Inflation and income elasticity may have inverse relationship, implying that during the periods of extreme inflation, the money velocity rises and it is likely that income elasticity will fall because agents may economize their holdings of money. The interest and exchange rates also provide considerable uncertainties about asset returns. These two proxies may also be associated with lowering the point income elasticity of money demand. For more details about exchange rate impacts on the demand for money, see, for example, Bahmani-Oskooee and Tanku (2006), Bahmani-Oskooee and Rehman (2005) and Bahmani-Oskooee and Shabsigh (1996).

Table 5 reports the results on how these opportunity cost variables have influenced the income elasticities in advanced and developing countries. The interest rate estimate (columns 1 and 4) seems to have a significant negative impact on income elasticities in both advanced and

² We report only the CUSUMSQ plots for columns 2 and 4. Other test results could be obtained from the authors upon request.

³ For convenience, only CUSUMSQ plots are reported.

Table 5. Income elasticities and opportunity cost of holding money

Dependent variable: income elasticity						
Variables	Advanced countries			Developing countries		
	(1)	(2)	(3)	(4)	(5)	(6)
Broad money	0.287 (2.24)*	0.348 (1.81)**	0.260 (1.90)**	0.030 (1.97)*	0.024 (1.70)**	0.017 (1.75)**
Interest rate	-0.175 (2.40)*			-0.034 (2.96)*		
Exchange rate		-0.077 (1.74)**			-0.010 (1.44)	
Inflation rate			-0.008 (1.83)**			-0.006 (1.19)
Intercept	2.008 (1.45)	0.841 (2.82)*	1.270 (2.42)*	2.465 (5.82)*	2.120 (2.15)*	1.544 (4.74)*
Number of observations	251	251	251	268	268	268
R^2	0.38	0.39	0.39	0.40	0.37	0.37

Notes: The absolute t -ratios are given in the parentheses.
* and ** denote significance at 5% and 10% levels, respectively.

developing countries. However, this impact is higher in the advanced countries than in the developing countries sample. The inflation rate (columns 3 and 6) and exchange rate (columns 2 and 5) are statistically significant only at the 10% level in the advanced countries sample, while statistically insignificant at the conventional levels in the developing countries sample. These results imply that the conventional money demand specification is still feasible. Further, estimations that utilize data especially from the advanced countries should consider testing the significance of various costs of holding money proxies (e.g. inflation and exchange rates) to achieve robust estimates of income elasticity. The CUSUM and CUSUMSQ tests revealed that all estimated equations in Table 5 are stable. For convenience, I report only the CUSUMSQ tests for columns 1 and 4 (see Figs A1 and A2 in the 'Appendix' section).

Estimation methods

The individual money demand studies differ in many ways; however, there is lack of theoretical evidence to support how the additional factors influence the estimated income elasticities. Among others, estimation techniques do play a vital role in empirical analysis of money demand. A number of existing studies have used the system-based method of Johansen's (1988) maximum likelihood (JML), while others have employed single-equation techniques like the Hendry's (1995) general to specific (GETS), Engle and Granger's (1987) two step, Phillip and Hansen's (1990) fully modified OLS (FMOLS), Stock and Watson's (1993) dynamic OLS (DOLS) and Pesaran *et al.*'s (2001) autoregressive distributed lag model (ARDL).

Table 6. Subsample estimates

Dependent variable: income elasticity						
	Advanced countries			Developing countries		
	(1) Multi variate	(2) Single equation	(3) Stability tests	(4) Multi variate	(5) Single equation	(6) Stability tests
Broad money	0.268 (2.96)*	0.243 (1.70)**	0.297 (2.76)*	0.049 (2.85)*	0.025 (2.25)*	0.020 (1.78)**
Narrow money	0.157 (1.72)**	0.102 (1.84)**	0.095 (2.14)*	0.017 (1.71)**	0.024 (1.68)**	0.019 (2.27)*
Intercept	0.945 (3.26)*	1.236 (2.65)*	1.548 (3.92)*	1.636 (3.79)*	2.044 (3.52)*	0.840 (1.85)**
Number of observations	153	98	205	144	124	192
R^2	0.37	0.36	0.39	0.37	0.37	0.36

Notes: All models include country-specific dummies. The absolute t -ratios are in the parentheses.
* and ** denote significance at 5% and 10% levels, respectively.

It is interesting to investigate how the alternative estimation methods have influenced the income elasticities in this literature. In columns 1 and 4 (2 and 5) of Table 6, we focus on income elasticities that have been estimated using the multivariate (single-equation) methods. Essentially, these income elasticities are grouped so that two sets of subsamples for advanced and developing countries are developed, respectively. The third set of subsample is based on the stability tests. The stability of the money demand function has been tested by a number of studies, and some frequently used tests are Brown *et al.*'s (1975) CUSUM and CUSUMSQ tests, Hansen (1992) and Gregory and Hansen's (1996a, b) structural break tests, Nyblom's (1989) type tests and Chow tests. Columns 3 and 6 relate to the sample of studies that tested for money demand stability. Using these subsamples the income elasticity was regressed on broad and narrow money aggregates.

In Table 6, all the estimated coefficients have expected signs and are statistically significant at the conventional levels. These estimates provide a clear indication that there are no significant differences in the income elasticities when multivariate or single-equation techniques are used. This is also quite apparent in Figs 2 and 3. In the time series literature, Smith (2000) and Rao (2007) argued that alternative estimation methods may yield consistent estimates if they are applied appropriately and if data are reliable. Further, the stability tests seem to have negligible impacts on the income elasticities. Stability tests confirmed that all the estimated equations are largely stable.⁴

V. Conclusions

In this article, we utilized the meta-regression analysis to investigate the sources of variations in the income elasticities of money demand. We adopted the approach employed in Knell and Stix (2005, 2006); however, we extend the analysis to examine study characteristics for two samples, that is, advanced and developing countries. Since the financial market institutions and their characteristics in the advanced countries are fairly different from the developing countries, it is therefore vital to perform meta-analysis for the two samples separately. Our findings reveal that for advanced countries the income elasticities of money demand are significantly higher if broader definitions of the monetary aggregates are used. This result does not hold for the developing countries sample. This implies that the substitution effects (portfolio decisions) seem to be more relevant in the advanced countries. As income rises, agents substitute narrow money (e.g. notes and coins) for broad money (e.g. credit and debit cards). The growth in income is low in the developing countries, and thus this offers less opportunity for substitution.

The inclusion of wealth and financial reforms dummies seems to have significantly reduced the estimates of the income elasticity in the advanced countries sample. In contrast, wealth (financial reform) impacts on income elasticity are statistically insignificant (weakly significant) in the developing countries sample and both seem to have reduced the income elasticity estimates only marginally. Since the per capita wealth in the developing

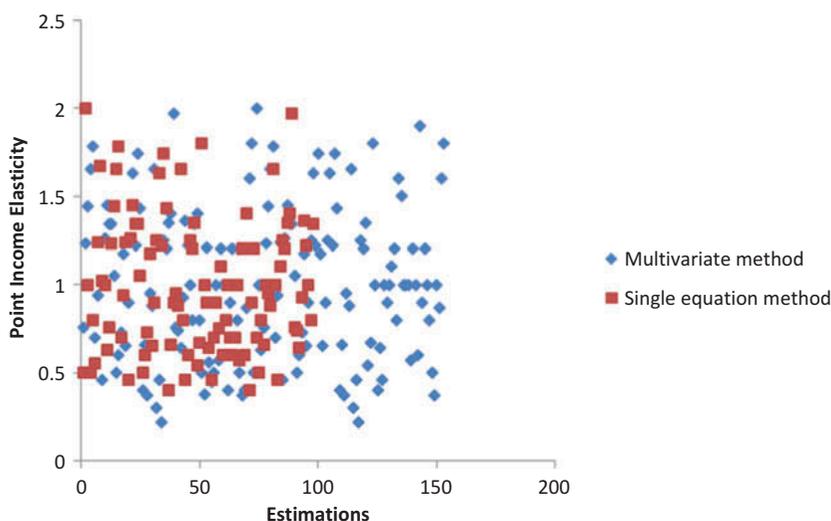


Fig. 2. Income elasticity estimates of the advanced OECD countries

⁴These results (CUSUM and CUSUMSQ) are not reported, but can be obtained from the authors upon request.

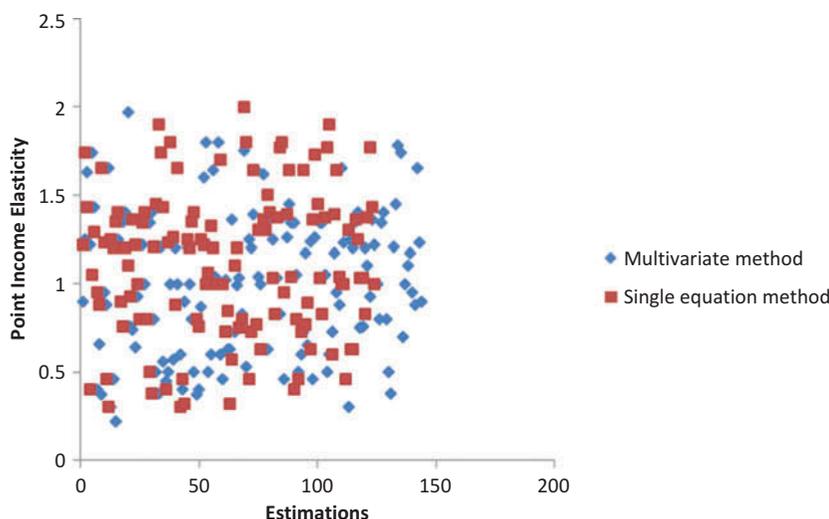


Fig. 3. Income elasticity estimates of the developing countries

countries is low, it is plausible that wealth effects on income elasticity may be minimal. Most advanced countries have continually liberalized their financial markets, and it is expected that these reforms may have created some economies of scale in the demand for money. However, most developing countries generally face financial constraints to invest in the financial sector and payments technology. Consequently, reform policies in most developing countries are not sustainable. To this end, reforms may have produced minimal scale economies in the money demand for the developing countries.

Moreover, in the case of the developing countries sample, the inflation and exchange rates do not seem to have statistically significant impacts on the income elasticity. However, alternative proxies for costs of holding money (e.g. inflation and exchange rates) are important in money demand estimations for the advanced countries and these seem to reduce the income elasticity estimates. We also find that the income elasticities are unaffected by other characteristics, for example, type of econometric techniques used. We found that there are no significant differences in the income elasticities when multivariate or single-equation techniques are employed. The same applies for studies that utilized stability tests.

There may be a number of limitations to our study. It is possible that some of the studies we have chosen may suffer from omitted variable bias, estimation problems, data limitations, etc. Moreover, there may be heterogeneity between the studies which can lead to aggregation problems. To address these limitations, we were fairly firm on our study selection criteria. To this end, a number of studies were ignored due to their results being very different (outliers) from other studies.

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Appendix

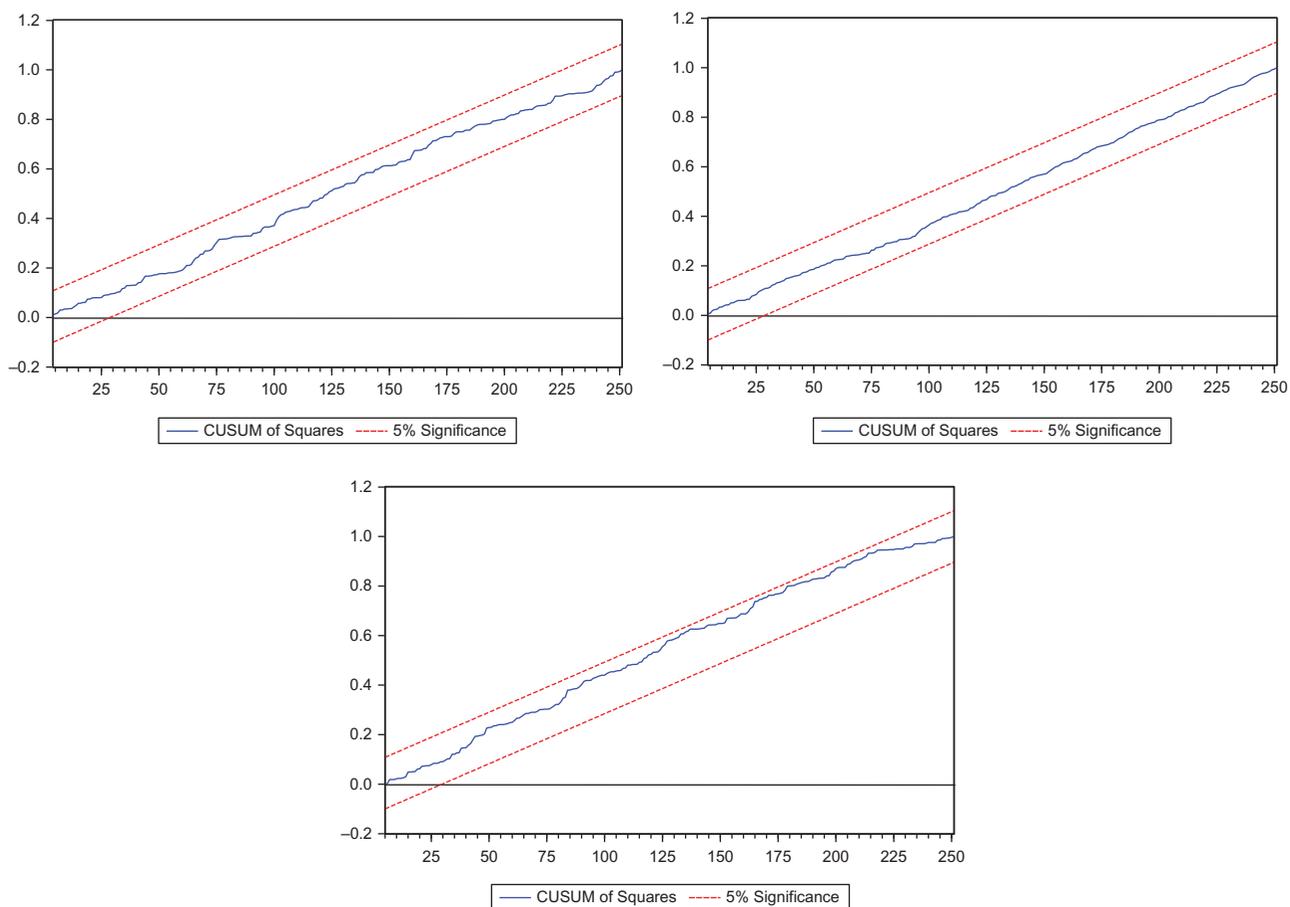


Fig. A1. CUSUMSQ plot for the advanced countries

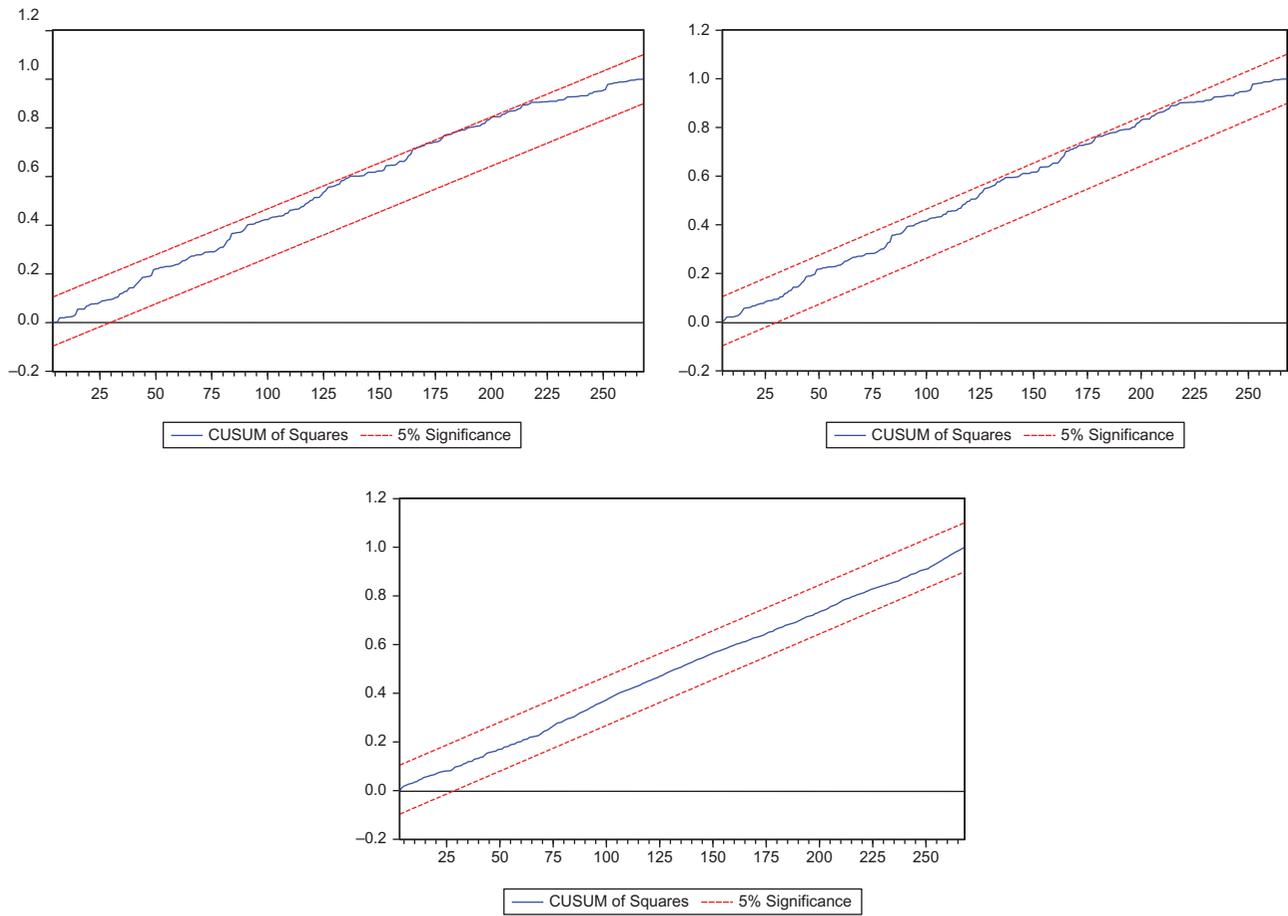


Fig. A2. CUSUMSQ plot for the developing countries