WP-2013-019

Sector GDP Concentration Bias in the Macro-Money Demand Specification: New Evidence for India

Subrahmanyam Ganti, Sridhar Telidevara

Indira Gandhi Institute of Development Research, Mumbai
September 2013
http://www.igidr.ac.in/pdf/publication/WP-2013-019.pdf

Sector GDP Concentration Bias in the Macro-Money Demand Specification: New Evidence for India

Subrahmanyam Ganti, Sridhar Telidevara
Indira Gandhi Institute of Development Research (IGIDR)
General Arun Kumar Vaidya Marg
Goregaon (E), Mumbai- 400065, INDIA
Email (corresponding author): sganti@igidr.ac.in

Abstract

Money serves as an intermediate target variable for transmitting monetary policy actions in macroeconomic management. In this connection, no other macro-behavioural function is subjected to more modelling modifications and regression rigors than the macro-money demand function. Monetary policy planning crucially depends on the parameters of the money demand function. An emerging market economy undergoes structural change in the sector GDP composition when compared to that of a structurally (invariant) mature advanced economy. This obviously introduces a bias in the estimation of the income elasticity of money demand parameter if the structural change were not modelled into the money demand function. The present study tries to incorporate this structural change into the money demand function as an additional variable besides the aggregate GDP and interest rate as the conventional scale and opportunity cost parameters variables respectively. The simplified algebra permits us to proxy the sector GDP concentration variable by the numbers equivalent Herfindahl index(H) For the opportunity cost variable,1-3 year deposit rate and the call money rate are alternatively used. Maximum Likelihood estimates of the have thrown up a statistically highly significant positive coefficient of the H variable besides equally highly significant scale and opportunity cost variables with their expected positive and negative coefficients respectively. This empirical evidence suggests that without this variable, the conventional specification of the money demand function contains a serious policy-centric specification error. Also, the implication of the result is that as the sector GDP concentration increases, the demand for real money balances increases less proportionately, indicating presence of economies of scale.

Keywords: Sector GDP Concentration, Macro-Money Demand Specification, Numbers Equivalent Herfindahl Index

JEL Code: E01, E41, E51 and E52

Acknowledgements:

The authors thank Ms. Ramyani Mukhopadhyay Research Scholar, IGIDR) for typing assistance.

Sector GDP Concentration Bias in the Macro-Money Demand Specification: New Evidence for India

Subrahmanyam Ganti*

Sridhar Telidevara**

"A model is simply three-pronged

One is straight math-ganged

Second is my version-fanged

And third is truth-tongued"

Anonymous

Abstract

Money serves as an intermediate target variable for transmitting monetary policy actions in macroeconomic management. In this connection, no other macro-behavioural function is subjected to more modelling modifications and regression rigors than the macro-money demand function. Monetary policy planning crucially depends on the parameters of the money demand function. An emerging market economy undergoes structural change in the sector GDP composition when compared to that of a structurally (invariant) mature advanced economy. This obviously introduces a bias in the estimation of the income elasticity of money demand parameter if the structural change were not modelled into the money demand function. The present study tries to incorporate this structural change into the money demand function as an additional variable besides the aggregate GDP and interest rate as the conventional scale and opportunity cost parameters variables respectively. The simplified algebra permits us to proxy the sector GDP concentration variable by the numbers equivalent Herfindahl index(H) For the opportunity cost variable,1-3 year deposit rate and the call money rate are alternatively used. Maximum Likelihood es**timate**s of the have thrown up a statistically highly significant positive coefficient of the H variable besides equally highly significant scale and opportunity cost variables with their expected positive and negative coefficients respectively. This empirical evidence suggests that without this variable, the conventional specification of the money demand function contains a serious policy-centric specification error. Also, the implication of the result is that as the sector GDP concentration increases, the demand for real money balances increases less proportionately, indicating presence of economies of scale.

Key Words: Sector GDP Concentration, Macro-Money Demand Specification, Numbers Equivalent Herfindahl Index

JEL Classification Numbers: E01, E41, E51 and E52.

1.Introduction:

In the emerging market economies, monetary targeting arrived in very late and soon after departed too. What was once a unilateral monetary target variable now remains reduced to a mere information-variable status. Every policy points to the fact that one should not accept things by the model alone because a model that is out of season may misguide a whole policy time. A meaningful modification, sometimes, is said to save tons of policy procrastinations. Thus, one should never complain about modifications of the conventional models whenever and wherever necessary, especially, if the conventional models are taken for a straight-forward transplantation into the structurally evolving emerging economies.

The standard macro-money demand function, as specified in the macro-models of the emerging market economies, stands as one such transplantation. This type of transplantation from a structurally mature advanced economy model into a structurally evolving emerging market economy framework tends to misguide policy formulation and implementation. The general aggregation bias arising out of going from the micro to the macro specification always abounds and the macro-money demand function is no exception. This wider issue is not the concern of this study as it cannot be addressed here. The limited scope of the present study is to address the bias transmitted by the evolving structural change in the sector composition of the GDP into the money demand estimation. Shifts in the concentration with disparate-sector money demand propensities are likely to cause serious policy-oriented specification bias in the parameter estimates. Several estimates of bias due to disparate sources are already reported in earlier studies by the first author (Ganti, 2011, 2002, 1997-98, 1996, and 1990). The present study reports another model to estimating yet another bias.

The rest of the paper is organized as follows: Section 2 presents the derivation of the money demand aggregation involving the use of the Herfindahl index as the variable for measuring the sector-specific GDP concentration. Whereas section 3 reports the regression results and the implications for monetary policy, section 4 ends with some concluding remarks.

1. Aggregation of Sectoral Money Demand Functions:

We start with the standard money demand specification at the sector level as:

$$m_i = k\, y_i^{\alpha} e^{-\beta r} \qquad i= 1,2,\ldots n \qquad \text{---(1)}$$

where, $m_i = M_i/P_i$ is the i-th sector's real money demand(nominal money M_i deflated by the sector's output price level Pi) $y_i = Y_i/P_i$ is the i-th sector's real gross domestic product (nominal GDP Y_i divided by the sector's price level Pi). The opportunity cost variable is denoted as 'r' and is assumed the same across all the sectors. Also 'k' is the transactions technology level, assumed the same across the sectors. Parameters α and β are income elasticity of money demand and semi-interest elasticity respectively, once again assumed the same across the sectors for convenience. Aggregation of (1) over the sectors can be written as:

$$\sum m_i = m = k\, e^{-\beta r} \sum y_i^{\alpha} \qquad \text{---(2)}$$

$\sum(Yi/P_i) = y$ only if $\alpha=1$, a priori. But this is the parameter of interest for estimation and testing. Let us assume further that $y_i = \lambda_i y$ where λ_i is a given for each sector. Then

$$m_i\, k\, e^{-\beta r} (\lambda_i y)^{\alpha} \qquad \text{---(3)}$$

Since in equation (3) λ_i is the share of the i-th sector output in the total economy GDP, we can rewrite equation (3) as:

$$m = k\, e^{-\beta r}\, y^{\alpha} \sum \lambda_i^{\alpha} \qquad \text{---(4)}$$

To deal with the last term in the R.H.S. of equation (4) we introduce the Herfindahl index[1]. The Herfindahl index is defined, in general, as the sum of squares of shares of components of an aggregate in the aggregate. It is popularly used to measure market concentration across firms in a market. This Index has several desirable properties including scale invariance and direct relation to several variability measures such as the Gini coefficient and coefficient of variation[2]. For purposes of our study, the H index is used as a measure of sector GDP composition

concentration only if $\alpha = 2$. But, this parameter being the income elasticity of demand for real money balances, we shall not impose this restriction a priori. Therefore, to get around this problem, we use the numbers equivalent of the Herfindahl index measure (H). It is a useful and popular approximation widely applied in both the theoretical and empirical research studies. The number of equal-sized sectors corresponding to any H value is given as $n = 1/H$ where n is the number of sectors. Using this transformation we can write

$$\sum \lambda_i^{\alpha} = \sum H^{\alpha} = H^{\alpha-1} \qquad \text{---(5)}$$

Now we write the macro-money demand specification as:

$$m = k\, e^{\beta r}\, y^{\alpha}\, H^{\alpha-1} \qquad \text{---(6)}$$

We need to remember that $H^{\alpha-1}$ is only a useful approximation because it does take into account the sector GDP distribution effects on the macro-money demand specification. Further, for any given degree of unequal sector composition, the closer alpha is to unity the better the approximation. The log-linear form of (6) for econometric estimation is written as:

$$\text{Log}(m) = \log k - \beta r + \alpha \log y + (\alpha-1) \log H \qquad \text{---(7)}$$

Where Log= natural logarithm, m= M/P is real narrow money balances, r= rate of interest proxied by the 1-3 year deposit rate and the call money rate alternatively, Y= GDP/P real gross domestic product, and H is sum of the squares of the shares of the sector real outputs in the total economy real GDP. For purposes of measuring H the following sectors and shares are taken in the computation of the H: (i) Agriculture and Animal Husbandry; (ii) Mining; (iii) Manufacturing; (iv) Electricity; (v) Construction; (vi) Trade and Transport; (vii) Finance and Real Estate Services and (viii) Community Services. For efficient estimation, it is obvious to see that the estimation of parameter α is to be restricted to be the same in the last two variables of equation (7). In view of this restriction, ordinary least squares (OLS) method is not applicable as it yields an inefficient estimate of α. Hence the maximum likelihood (ML) method is used to obtain an efficient estimate of α.

2. Regression Results and Implications:

Tables 1&2 report the ML estimates of equation (7) with 1-3 year deposit rate and the call money rate respectively for the opportunity cost variable. Parameter estimates are reported for the pre(1970-1991) and post(1992-2011) liberalization periods. For completeness the estimates are also reported for the entire period (1970-2011). The results that interest us most are those for the post-liberalization period in both the Tables. Looking at the regression results in both the Tables, one can easily see that the income elasticity of money demand estimate for M1 turns out to be greater than unity contrary to conventional conviction. Then, the result that is of most interest to us is the estimate of the coefficient of the H variable. The estimate reports the elasticity of real money demand with respect to the H variable. The interesting result is that the estimates in both the regressions with call rate and 1-3 year deposit rate are very close and are around 0.2. The individual estimates of 0.177 and 0.2 are highly significant at better than 1% significance level. Also, the sign of the coefficient estimate is positive as expected. The implication is that for every 10 percent increase in H- the number of sectors remaining the same- would lead to a 2 percent increase in the demand for real money balances. This result is highly interesting, despite the use of the numbers equivalent of H. The estimate 0.177 or 0.2 of the coefficient of H suggests that there exist economies of scale in the demand for real M1 with respect to increases in H. It means that a higher H would lead to less than proportionate increase in the demand for real M1. This is what is to be expected, as it implies that increasing concentration towards the services sector in the later stages of development of an economy-as in case of the Indian economy- would turn out to be beneficial as it would not lead to proportionate increase in the demand for real M1. It also means that ignoring the sector concentration of the economy-wide GDP would result in misleading monetary arithmetic for policy planning. Failure to acknowledge this empirical fact could give rise to distorted policy consequences.

Table 1 ML Estimates of equation: ln(m1) = β0 + β1 ln(y) + (β1-1) ln (H)+ β2 (1-3 yr deposit rate)

Independent Variable	Period 1970-1991	Period 1992-2011	Period 1970-2011
lny	0.946 (9.131)[a]	1.177 (40.142)[a]	1.183 (91.366)[a]
lnH	-0.054 (-0.518)	0.177 (6.068)[a]	0.183 (14.122)[a]
1-3 yr Deposit Rate	0.630 (0.496)	-1.262 (-2.344)[b]	-1.429 (-3.624)[a]
Constant	-0.996 (-0.606)	-4.677 (-8.655)[a]	-4.777 (-21.460)[a]
Sigma of the ML	0.045 (6.633)[a]	0.043 (6.325)[a]	0.048 (9.165)[a]
N	22	20	42
Likelihood	37.05	34.37	68.22
Chi-square	398.772	2382.997	8354.636
Legend	m1 = M1/P; y = Y/P; H=Herfindahl Index; N= Number of Observations, ML = Maximum Likelihood; Numbers in parenthesis are computed t-values; a = p<0.01 and b = p<0.05		

Table 2 ML Estimates of equation: ln(m1) = β0 + β1 ln(y) + (β1-1) ln (H) + β2 (call rate)

Independent Variable	Period 1970-1991	Period 1992-2011	Period 1970-2011
lny	0.909 (14.563)[a]	1.200 (35.275)[a]	1.172 (77.855)[a]
lnH	-0.091 (-1.453)	0.200 (5.883)[a]	0.172 (11.450)[a]
Call Rate	0.724 (1.952)[c]	-0.254 (-0.616)	-0.407 (-1.595)
Constant	-0.396 (-0.389)	-5.181 (-8.349)[a]	-4.682 (-17.582)[a]
Sigma of the ML	0.042 (6.33)[a]	0.049 (6.325)[a]	0.053 (9.165)[a]
N	22	20	42
Likelihood	38.69	32.13	63.74
Chi-square	466.177	1900.873	6741.990
Legend	m1 = M1/P; y = Y/P; H=Herfindahl Index; N= Number of Observations, ML = Maximum Likelihood; Numbers in parenthesis are computed t-values; a = p<0.01 and c = p<0.10		

3. Concluding Remarks: The purpose of this short paper is to signal a call for continued research into the hidden sources of bias that exist in the formulation and estimation of the macro-money demand function. It is demonstrated statistically how sector GDP distribution affects the demand for real money balances in addition to the aggregate GDP as scale variable. Although the omission of H would not cause very serious large scale bias, it would still distort the policy picture.

It is empirically validated once again in this paper that how the conventional scale variable of GDP needs the specification-support of the sector GDP concentration in an unconventional interrelationship. For an emerging market economy like that of India, a careful resolution of the potential biases would help minimize the scope for policy errors. Thus, a blanket dismissal by some conventionalists, of such essential specification-modifications as reported in this study would cause unnecessary and premature policy procrastinations.

---

*[1] Visiting Fcaulty, Indira Gandhi Institute of Development Research (IGIDR), Mumbai, India.

** [1] Associate Professor, GITAM School of International Business, GITAM University, Visakhapatnam, A.P.,India.

The authors thank Ms. Ramyani Mukhopadhyay (Research Scholar, IGIDR) for typing assistance

Notes

[1] The Herfindahl index was originally proposed and used in the field of industrial economics by Herfindahl (1955) and Hirshman (1964) independently of each other. Later, it was commented upon the first time by Adelman (1969) and then firmly linked to economic theory by Cowling and Waterson (1976)

[2] Scale invariance is ensured in the sense that even if all the component sector output shares are multiplied by a constant each, sum of all the sector output share-squares remains the same. The direct connection to the Gini coefficient and the coefficient variation can be easily seen from the following relationships: H = (square of coefficient of variation + 1) /n. This is derivable from the definition of coefficient of variation and H. Since Gini coefficient and coefficient of variation are equivalent for a normal distribution, H = (square of Gini coefficient + 1) /n (Djolov, 2009)

References

1. Adelman, M.A., "Comment on the H concentration measure as a numbers-equivalent", The Review of Economics and Statistics, Vol.51,(February 1969) pp.99-101.

2. Cowling,K and M. Waterson, "Price-Cost Margins and Industry Structure", Economic Journal,Vol.43,(June 1976) pp.267-274.

3. Dickson,V., "Aggregate Industry Cost Functions and the Herfindahl Index", Southern Economic Journal,Vol.61, (October 1994) pp.445-452.

4. Djolov,G., "Methodological Challenges in Measuring Business Concentration as a Official Statistic:The Case of the Hirshman-Herfindahl Index", Paper presented at a Conference of International Statistical Institute (Durban, South Africa,2009) pp.1-18.

5. Ganti Subrahmanyam and B.Padma Narayan, "Sectoral Composition Bias in Money Demand: Some Evidence for India", The IUP Journal of Applied Economics, Vol.X (2011) pp.56-63.

6. Ganti Subrahmanyam, “Kinks in the Empirical Money Demand Function for India”, The Indian Economic Journal: Special Number in Monetary Economics, Vol.46 (July-September 1997-98) pp.12-19.

7. Ganti Subrahmanyam and Swami,S.B., “Monetization and Economic Growth: A New Approach and Evidence”, Prajnan: Journal of Social and Management Srudies,Vol.19 (April-June 1990) pp. 127-134.

8. Ganti Subrahmanyam “Some Potential Biases in the Standard Money Demand Function for India”, in Raj Kumar Sen and Biswajit Chatterjee(eds.) Indian Economy:Agenda for the 21st Century (Essays in Honour of Professor P R Brahmananda) Himalaya Publishing House (2002) pp. 303-316.

9. Ganti Subrahmanyam “Economic Sectoral Bias in the Macro-Money Demand Function for India:Some Evidence”, Journal of Economic and Social Measurement, Vol.22 (December 1996) pp. 219-230.