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How Important Are Economic (Divisia) Monetary Aggregates for Economic Policy?

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A Divisia User Cost of Money for Emerging Economies

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Abstract

A growing literature on Divisia monetary aggregation focuses on emerging economies. Sizable proportions of the populations of these economies face financial accessibility and wealth constraints. We propose a modified user-cost of money in an economic environment where a fraction of consumers are wealth-constrained. The derived user-cost is a weighted average of the subjective user-costs of constrained and unconstrained agent. Our user-cost is consistent with the canonical Barnett (1978) and Barnett (2000) user cost when all agents are not wealth-constrained but accounts for an additional "social" opportunity cost when a fraction of consumers do not have access to wealth.

JEL Classification: E62, E63, H63

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1 Introduction

There exists an extensive literature on the theory, empirics, and policy application of Divisia monetary aggregates for developed economies such as the US, Israel, Japan, and the European Union (e.g., Barnett, Keating and Chae, 2006; Barnett, Offenbacher and Spindt, 1984; Barnett, Chauvet and Leiva-Leon, 2016a; Belongia and Ireland, 2015; Serletis and Istiak, 2016; Belongia and Ireland, 2017; El-Shagi, Giesen and Kelly, 2015). Recently, a new literature focusing on developing and emerging economies is cropping up, and these studies, like their predecessors employ a representative agent based user-cost of money for computing the growth weights of the individual monetary assets. The representative agent assumption is foundational in the measure of user-cost of money, derived in Barnett (1978). While this assumption is usually consistent for modeling developed countries, it 'over' aggregates the types of consumers in developing and emerging economies who are potentially more heterogeneous based on wealth inequality and access. More precisely, a well-known characteristic of emerging economies is the presence of economic agents who are constrained in financial markets due to income levels, gender, education level, or social capital.[1] While all agents in an economy may have access to one form of monetary asset or another (e.g. currency), they tend not to have access to channels of wealth accumulation–e.g. equities, long term bonds, large value certificates of deposit, or real estate. This inequality in the access of wealth exists in developed economies, however the heterogeneity is more marked in emerging economies.[2] It would therefore improve the accuracy of the measure of monetary flow to account for this inequality.

The Center for Financial Stability (CFS) keeps a running list of research on Divisia monetary aggregate, including works on China, India and Saudi Arabia; countries where wealth inequality implies a case for the use of heterogeneous agents when solving for the user costs of money[3]. The Africa Growth Initiative at Brookings also recently released a report on Divisia money in Kenya, highlighting the relevance of the Divisia monetary aggregate in developing economies.[4]These aggregates are particularly important for monetary policy evaluation and welfare analysis as demonstrated in Keating *et al.* (2016) and Belongia and Ireland (2017) for a developed economy with relatively easy access to financial markets like the US. Given the presence of wealth-constrained agents in emerging economies, if researchers wish to construct consistent Divisia aggregates for policy analysis in developing and emerging economies, the heterogeneity problem must be developed.

The concept of wealth-constrained agents is not new and is applied in several general equilibrium models to explain popular economic puzzles, redistribution effects, and the study of macroeconomic implications of monetary and fiscal policy (Kaplan *et al.*, 2016; Gali *et al.*, 2004; Campbell and Mankiw, 1989; Mankiw, 2000; Prasad and Zhang, 2015; Dosi *et al.*, 2013, to mention a few). An extension in the Divisia literature to account for such wealth-constrained agents households is a natural step.[5] Barnett *et al.* (2016b) and Barnett and Su (2017) develop a methodology and data set to include the liquidity services of credit card accounts. Further Barnett and Su (2016) the risk adjustment literature started in Barnett and Wu (2005) for monetary assets that may hold more risk than others. In recognizing the potential demographic

[1] For evidence of wealth inequality in developing and emerging economies and their implications to economic and social outcomes (See Dabla-Norris *et al.*, 2015; Deaton, 2003; Dosi *et al.*, 2013; Li *et al.*, 2017; Aron and Muellbauer, 2013, for example)

[2] For instance, Saez and Zucman (2016) discusses wealth inequality in United States since 1913.

[3] Extensive research on the China and Saudi Arabia cases can be found in Barnett and Tang (2016) and Barnett and Alkhareif (2015)

[4] See Khainga (2014) for theoretical and empirical details.

[5] In the Divisia literature the concept of heterogeneity itself is not new. Studies such as xxx have but there is no study that considers explicitly wealth constrained agents. This therefore is the primary contribution/focus of this paper.

diversity among households with respect to wealth, this paper opens Divisia monetary aggregates to the additional rich dynamics that inclusion of heterogeneous households agents bring to optimizing models and provides a path for improved empirical work.

With the continued growth in the research of Divisia monetary aggregates in emerging economies and the unique characteristics of these economies, an appropriate measure is required. We derive a modified user cost drawing all of its foundations from Barnett (1978) but explicitly including the presence of wealth-constrained agents. This type of heterogeneity among agents generated by the deprivation of financial access to wealth by a fraction of household agents adds an additional twist the canonical user-cost.

2 Assumptions and Notation for the Proposed Model

As standard in the literature we define the variables for the two consumers:

$\lambda =$ fraction wealth-constrained restricted agents

$\mathbf{x}_s^u =$ vector of per capita (planned) consumption of N goods and services (including those of durables) during period s of unrestricted agents

$\mathbf{x}_s^r =$ vector of per capita (planned) consumption of N goods and services (including those of durables) during period s of resricted agents

$\mathbf{x}_s \equiv \lambda \mathbf{x}_s^r + (1-\lambda)\mathbf{x}_s^u =$ vector of per capita (planned) consumption of N goods and services (including durables) during period s of the entire economy

$\mathbf{p}_s =$ vector of goods and services expected price, and of durable goods expected rental prices during period s

$m_{i,s}^u =$ planned per capita real balances of monetary asset i during period of goods and services expected price, and of durable goods expected rental prices during period s households

$m_{i,s}^r =$ planned per capita real balances of monetary asset i during period of goods and services expected price, and of durable goods expected rental prices during period s for restricted households

$m_{i,s} \equiv \lambda m_{i,s}^r + (1-\lambda) m_{i,s}^u = m_{i,s}^r = m_{i,s}^u$ aggregated planned per capita real balances of monetary asset i during period of goods and services expected price, and of durable goods expected rental prices during period s of the entire economy

$r_{i,s} =$ expected nominal holding period yield (including capital gains and losses) on monetary asset i during period s

$A_s \equiv (1-\lambda) A_s^u =$ planned per nominal holding period yield (including capital gains and losses) on monetary asset i during period s

$R_s =$ expected (one-period holding) yield on the benchmark asset during period s

$L_s \equiv L_s^r \equiv L_s^u =$ per capita labor supply during period s

$w_s =$ expected wage rate (common for both agents) during period s

$p_s^* = p_s^*(\mathbf{p}_s)$ is the true cost of living index, as defined in Barnett (1978)

Unconstrained Household Problem: Choose the deterministic point $(\mathbf{m}_t^u, \mathbf{c}_t^u, \mathbf{x}_t^u, A_t)$ to maximize,

$$\sum_{t=0}^{\infty} \beta_u^t u^u(\mathbf{m}_s^u, \mathbf{x}_s^u),$$

s.t

$$\mathbf{p'}_t\mathbf{x}_t^u = w_t L_t^u + \sum_{i=1}^{n}[(1+r_{i,t-1})p_{s-1}^* m_{i,t-1}^u - p_s^* m_{i,t}^u] + [(1+R_{t-1})p_{t-1}^* A_{t-1}^u - p_{t-1}^* A_t^u$$

and the transversality condition:

$$\lim_{T\to\infty} \beta^T A_{T+1} = 0 \tag{1}$$

FOC of Unrestricted Household:

$$\frac{\partial u^u}{\partial X_t^u} = \Lambda_t^u p_t^* \tag{2}$$

$$\frac{\partial u^u}{\partial m_{i,t}^u} - \beta_u(1+r_{i,t})p_t^*\Lambda_{t+1}^u + \Lambda_t^u p_t^* = 0 \tag{3}$$

$$-\beta_u\Lambda_{t+1}^u(1+R_t)p_t^* + \Lambda_t^u p_t^* = 0 \tag{4}$$

We can derive the Euler Equations:

$$\mathrm{E}_t\left[\frac{\partial u}{\partial m_{i,t}^u} - \beta_u(R_t - r_{i,t})\frac{p_t^*}{p_{t+1}^*}\frac{\partial u}{\partial X_{t+1}^u}\right] = 0 \tag{1u}$$

$$\mathrm{E}_t\left[\frac{\partial u}{\partial X_t^u} - \beta_u(1+R_t)\frac{p_t^*}{p_{t+1}^*}\frac{\partial u}{\partial X_t^u}\right] = 0 \tag{2u}$$

Wealth-Constrained Households: In a typical developing and emerging economy, one will observe that there is a fraction of agents whom simply do not have access to wealth accumulation. Thus, the key difference between the two agents is the absence of wealth, A_t in the restricted agents budget constraints. This is due to the inaccessibility of wealth discussed earlier. Thus, these agents do not receive any returns on benchmark assets.

$$\sum_{t=0}^{\infty}\beta_r^t u^r(\mathbf{m}_s^r, \mathbf{x}_s^r),$$

s.t

$$\mathbf{p'}_t\mathbf{x}_t^r = w_t L_t^r + \sum_{i=1}^{n}[(1+r_{i,t-1})p_{s-1}^* m_{i,t-1}^r - p_s^* m_{i,t}^r]$$

FOC for Restricted Households:

$$\frac{\partial u^r}{\partial X_t^r} = -\Lambda_t^r p_t^* \tag{5}$$

$$\frac{\partial u^r}{\partial m_{i,t}^r} - \beta_r \mathrm{E}_t(1+r_{i,t})p_t^*\Lambda_{t+1}^r + \Lambda_t^r p_t^* = 0 \tag{6}$$

combining Eq. (6) and Eq. (7)

$$\frac{\partial u}{\partial m^r_{i,t}} = \frac{\partial u}{\partial X^r_t} - \beta \mathrm{E}_t \left[(1 + r_{i,t}) \frac{p^*_t}{p^*_{t+1}} \frac{\partial u}{\partial X^r_{t+1}} \right] \tag{1r}$$

Defining the individual-specific user-cost for each agent type:

Definition 1. *The contemporaneous subjective user-cost real user cost price of the service of $m^i_{i,t}$ for each type of agents, $j \in \{u, r\}$ in the economy is $\wp^j$, defined such that,*

$$\wp^j_{i,t} = \frac{\frac{\partial u}{\partial m^j_{i,t}}}{\frac{\partial u}{\partial X^j_t}}, \qquad i = 1, 2, ..., n \ \text{ and } \ j \in \{u, r\} \tag{1a}$$

The definition for the contemporaneous user cost states that the real user price of a monetary asset is the marginal rate of substitution between that asset and consumer goods (Barnett, 1978).

From the definition above, the subjective user cost for unrestricted agents is,

$$\wp^u_{i,t} = \frac{R^*_t - r^*_{i,t}}{1 + R^*_t} \tag{1*}$$

Equivalently, a subjective user-cost for restricted agents can be defined as,

$$\wp^r_{i,t} = 1 - (1 + r^*_{i,t}) M^r_{t,t+1} \tag{2*}$$

where, $1 + r^*_{i,t} = \frac{p^*_t}{p^*_{t+1}}(1 + r_{i,t})$, $1 + R^*_t = \frac{p^*_t}{p^*_{t+1}}(1 + R_t)$ and the stochastic discount factor for restricted agents, $M^r_{t,t+1} = \beta_r \frac{\frac{\partial u}{\partial X^r_{t+1}}}{\frac{\partial u}{\partial X^r_t}}$ are defined for notational convenience. It is important to note that $M^r_{t,t+1}$ is the discount factor for restricted households.

3 Discussion

With consistent theory, we have derived subjective user costs for the two types of agents in the economy. To introduce a discussion of these preliminary results we will consider the case where $\mathcal{J}$ the user cost aggregate is a weighted average of the restricted and unrestricted households. This example converges to the traditional user cost as the deprivation of access for poor house holds goes to zero, and allows for some intuitive remarks.

A Weighted Average Example. *Under the heterogeneous household agent assumption, the ideal economy-wide real user cost price of the service of $m_{i,t}$ also known as the modified user cost of money is given by a generalized "unknown" function form $\wp^e_{i,t}$ governed by a function $\mathcal{J}$: ,*

$$\wp^e_{i,t} = \mathcal{J}(\wp^r_{i,t}, \wp^u_{i,t}, \lambda) \text{ and } \lim_{\lambda \to 0} \mathcal{J} = \pi_{i,t} \tag{7}$$

We examine a possible form for $\mathcal{J}$ satisfying Eq. (7) is $\wp^e_{i,t}$ and defined as the weighted average of the corresponding subjective user costs:

$$\wp^e_{i,t} = \lambda \wp^r_{i,t} + (1-\lambda)\wp^u_{i,t} \tag{8}$$

Specifically, from Eq. (1*) and Eq. (2*) we obtain,

$$\wp^e_{i,t} = \frac{R^*_t - r^*_{i,t}}{1+R^*_t} + \underbrace{\lambda\left[\frac{1}{1+R^*_t} - M^r_{t,t+1}\right](1+r^*_{i,t})}_{Q_t\text{: Social cost of Inaccessibility to wealth}} \tag{9}$$

where $Q_t > 0$, is a social opportunity cost incurred in the economy as a result of inaccessibility to wealth and it is weighted by the share of individuals constrained in the economy, λ.

Note that when $\lambda = 0$, the modified user cost equals the Barnett (1978) user cost. This ensures consistency in our proposed user cost with the usual user cost so that the subjective user cost with wealth-constrained agents can be modified easily to produce the extensively used homogeneous user cost. Intuitively, as financial access increases within an emerging economy the heterogeneous user cost will get closer and closer to the homogeneous user cost. In this case the user cost that involves the social opportunity cost penalizes the expenditure share weights based on the inaccessibility of wealth within the economy. In the weighted average form the penalty rises with increases in inaccessibility, increasing the user cost of monetary asset i.

Expanding on the intuition of the social opportunity cost, consider a household which on the basis of personal characteristics (threshold income to purchase bonds or acquire wealth, lack of adequate transportation, financial frictions to attain banking services) expects to be financially constrained. In this case, the expectation of future financial constraints induces the household to give up current consumption which is then translated to a fall in aggregate consumption driven by these disadvantaged individuals. The fall in consumption due to inaccessibility to wealth or bonds and $\lambda \neq 0$ drives a wedge in the traditional user-cost of money. Depending on the sign one can interpret Q_t as a socially induced opportunity cost or gain. The additional social cost can be thought of as a proxy for risk borne by the unrestricted households due to fluctuations in the consumption stream of restricted household. The social cost augments the original user cost formula by taking into account accessibility to wealth through the differences in the behavior of representative agents' consumption, and captures the realities of the structure of emerging economies.

The social opportunity cost also possesses important implications for the behavior of the household and preference of liquid assets on the whole. As an example consider the empirical case of the compression of user costs in Mattson and Valcarcel (2016). They argue that the user cost spread between typically low return (cash and checking accounts) and typically high return (money market mutual funds) assets can explain movement of value of monetary wealth to the more liquid assets. Households will not hold the less liquid money market mutual funds if the user cost of holding them is not significantly lower than cash or savings. In an emerging economy, the use of the traditional, unadjusted user cost could undervalue the user cost, missing a compression between much higher user costs for non-liquid assets comparable to the user cost for liquid assets like cash, which explains relatively higher cash holdings even in the presence of higher savings returns.

The user cost can be further adjusted to the case of emerging economies where wealth inequality has a dampening affect on liquidity service. The benchmark "store of value" asset which determines the benchmark rate, is key to deriving the proper user cost of each money type. But deprivation of access to the measure changes the price that some households pay in order to hold on to liquidity service. The changing price of that deprived representative agent captures the value of liquidity flowing through the economy; an important distinction of the

Divisia as a "flow" measure versus the uniformly priced simple sum measures. Our approach is also preferable to the limited focus on short term interest rates as policy indicators. Deprived households do not have access to the short term assets represented by this interest rate, but they do have access to currency and demand deposits. The user cost of these more liquid forms reflects the relative price of the most liquid forms of money in the economy used primarily by these households.

The form from Equation 8 demonstrates that $\lambda \neq 0$ ensures and induces an additional cost Q_t. However, the variability in Q_t is driven by the difference between the discounted rate of wealth and the discounted consumption growth of the restricted agents. For any positive value of λ, the user cost for monetary assets will be adjusted upwards as long as the differences between the interest rates are positive. This is true for any monetary asset, otherwise the negative user cost would make it a liability. Intuitively, because agents use wealth accumulation to smooth consumption and a fraction of agents (e.g. low income household) do not have access to wealth, they tend to consume sub-optimally. Such sub-optimal consumption imposes the additional social opportunity cost reflected in the subjective user costs, the growth weights, and ultimately the overall aggregate. An important feature of this social opportunity cost is that governmental policies–both monetary/fiscal– that aims at redistributing wealth in the economy by targeting such restricted households can actually have direct and nontrivial effects on the dynamics of the user cost of money, the demand of money, and hence money supply in the economy. In the context of emerging and developing economies such a this additional cost can serve as an appropriate measure of deprivation and help construct consistent Divisia monetary aggregate.

There is no first order condition foundation for our weighted average form, and alternative forms could be proposed and analyzed. One motivation for using this form relative to another construction is the literature on poverty measures. Nearly all poverty measures used in policy are based on the class of measures derived in Foster *et al.* (1984), which satisfy certain desirable properties. The ubiquity and simplicity of this form provides a ready example for understanding how increases or decreases in accessibility of financial markets and consumption growth would influence the user cost that is not present in more complex forms. The weighted average provides the intuitive penalization for wealth constraint; the amount of wealth constrained households adds to the user cost of holding monetary assets. The added cost is then carried on to the expenditure share weights placed on the growth rate of the aggregate index. A clear, additive trade off is present. The disadvantage to our example is that it is linear in nature, and overlooks stronger weighting in the extreme inequalities that would be captured in a geometric or exponential form. It would be more ideal to derive the functional form from the first order conditions, however given the preliminary nature of this note we leave that for future research.

The approach taken in this paper differs from other approaches taken in previous literature in its focus on the disparity of wealth in emerging economies. The most notable contribution of heterogeneous agents to the Divisia literature is Barnett (2007) , where a multilateral aggregation approach is taken to develop an aggregate for the European Union. In this case money holders from several different countries must be accounted for in measuring the supply of money over the large monetary union while still maintaining the differences between preferences and options among nations. Indeed the user cost derivation, originally demonstrated in Barnett (1978) is flexible to augmentation in taxation, inflation, risk adjustment, and multilateral aggregation not yet fully developed in the empirical literature. Barnett and Su (2016) establishes further the flexibility of the user cost approach to pricing of monetary aggregates by developing a credit card augmentation provided online now by the CFS. The user cost is flexible to different kinds of augmentation and heterogeneous approaches.

4 Concluding Remarks

The results in this paper echo the spirit of the Barnett Critique; better measures provide better analysis. The Divisia monetary aggregate construction helps to distinguish the contributing weight of different types of money based on their user costs, and to the point their rates of return as assets. We provide a theoretical foundation to incorporate the differences in access to certain monetary assets that uses what is known about inequality or poverty within an economy. Money strongly matters in the case of emerging economies which do not share the financial structure of the more extensively studied developed economies in the literature. Simple sum measures have already been established to be inferior metrics compared to the Divisia monetary aggregate. Further, the Divisia methodology derived in Barnett (2000) can be used to create improved metrics for the context of an emerging economy with wealth constrained households.

The short work in this paper can be thought of laying the foundation for more rigorous research in two broad perspective in the Divisia literature: (1) the theory of Divisia aggregation and (2) the empirical application of (1) in emerging and developing countries. A well-known challenge of Divisia aggregation is the aggregation over heterogeneous agents. We hope to build on this work and Barnett (2007) in extending Divisia user costs to a diversified environment of money users. This paper provides a significant contribution to the Divisia monetary aggregate literature in its extension of the user cost to heterogeneous household agents. The methodology follows Barnett (1978) but allows for heterogeneity among household agents which is generated by unequal access to wealth by a portion of economic agents. The presence of wealth constrained agents induces an additional cost– "inaccessibility penalty" on the user cost. The advantage of our proposed user cost is that it refines the aggregate and provides new information on the supply of monetary services in an emerging market context; significant difference in the constraints faced by representative households. Further, this simple modification can be used in pre-existing databases such as those provided by the CFS and by central banks around the world allowing for improved empirical and policy applications.

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