Abstract
Several countries including India and Uruguay have recently implemented policies that seek to disincentivize the use of paper currency. Despite its obvious policy relevance, there has been little work in the economics literature on the welfare effects of phasing out cash. This paper fills this void by analyzing the welfare effects in a quantitative model with tax evasion, random audits, multiple transaction mediums, and both formal and informal sectors. In the model people hold cash to facilitate transactions and to evade taxes in the informal sector. By phasing out cash, the government raises the effective tax rate but, since taxes are distortionary, lowers the tax base.

JEL Classification: E42; E51; E52; E26.

Keywords: Currency; Cash; Currency Suppression; Monetary Policy.

*E-mail address: jgarin@cmc.edu.
†E-mail address: last@uga.edu.
‡E-mail address: rblester@colby.edu.
1 Introduction

In light of recent proposals to suppress government-issued fiat currency, this paper takes a first pass as quantifying the welfare effects of such proposals in a general equilibrium setting. This paper reports on very preliminary work toward achieving the aim of assessing the overall costs and benefits of currency suppression proposals.

Proposals to eliminate currency have been around for a while, primarily motivated by attempts to increase the costs of tax evasion and illicit activity which are enhanced by the use of cash. However, doing away with paper currency has important tradeoffs: cash, even in large denominations, has many uses as a legitimate means of payment. Properly assessing the overall effects of eliminating currency or large note denominations requires quantitative, general equilibrium modeling that explicitly accounts for these tradeoffs.

Our preliminary work on this topic relies on a standard representative agent model that focuses on a particular use of cash – that of using currency to hide income to evade taxes. We model households' effective tax rates as being negatively related to the demand for currency, as opposed to bank deposits, thereby generating an additional demand for cash. We assume that the government sector can affect the productivity of cash as a tax evasion device, which we take to be tantamount to currency elimination. The model extends the early work of Rogoff (1998). The focus on tax evasion ignores other potentially illicit uses of cash (e.g. drug trafficking). Yet tax evasion is likely to be the most important underground use of cash (Rogoff, 1998, p. 59). Thus, examining the role of currency as it affects tax compliance behavior is important.

There is a large literature on tax evasion; for surveys see Slemrod (2007) and Alm (2012). Balafoutas et al. (2015) is a recent attempt to measure the costs of tax evasion, while Mazhar and Mon (2017) empirically the impact of the underground economy and tax revenues for developing and developed economies. Gordon (1990) is an early theoretical effort to examine the role of currency for tax evasion, but is not a general equilibrium analysis. Camera (2001) moves us in the right direction with a search-theoretic, general equilibrium framework that specifically models interactions between illegal activities and alternative media of exchange. Yet his model is complex and he provides no quantitative welfare analysis. Much work in this areas uses currency demand to estimate the size of the underground economy, as in Cebula and Feige (2012). This work is useful but none of these papers or those cited in the surveys provide direct estimates of welfare effects of currency demonetization, which motivates my paper.

\footnote{For example, Recommendation 24 of the Financial Action Task Force on Money Laundering of the OECD (1998) moves to combat money laundering by “encourag[ing] the replacement of cash transfers” through better money management.}
We emphasize that much of the current draft of this paper is preliminary work, and only sketches much of the analysis planned. We are currently working on a more extensive version of the analysis reported here.

2 Baseline model

The baseline economy is given by a standard representative agent model with a cash-in-advance constraint, where ‘cash’ consists of circulating currency (paper money, or banknotes) and checkable deposits. Currency and deposits are imperfect substitutes in satisfying the constraint; however, currency has an added value to the household in that it can be used to shield income from the government’s taxing authority and thus evade taxes. Thus, currency is an input into a tax-evasion technology that reduces effective income tax rates faced by households.

Households’ infinite-horizon, lifetime utility is

\[ V = \sum_{t=0}^{\infty} \beta^t \left( \ln c_t - \frac{\gamma n_t^{1+\chi}}{1+\chi} \right), \]  

(1)

where \( c_t \) is consumption and \( n_t \) is hours of labor supplied. All real quantities are in terms of the numeraire consumption good. Because there are no stochastic shocks, we assume perfect foresight. Households are subject to their cash-in-advance and asset-accumulation constraints, respectively:

\[ c_t \leq \left[ b_t^\rho + \psi d_t^\rho \right]^\frac{1}{\rho} \]

(2)

\[ m_t - m_{t-1} = \frac{y_t - T_t}{1+\pi_t} - c_t - i_t \]

(3)

where \( b \) is the stock of real currency, \( d \) is the stock of real checkable deposits, the real money supply \( m_t = b_t + d_t \), \( \pi \) is the rate of price-level inflation, \( y_t \) is real output, and \( i_t = k_{t+1} - (1-\delta)k_t \) is the rate of investment in physical capital. In the baseline formulation, the government’s central bank issues fiat currency and reserves, neither of which pay nominal interest. A private banking system exists solely to transform central bank reserves into checking accounts held by households. Banks’ checking account liabilities are fully backed by reserves; we can imagine that the central bank enforces a 100 percent reserve requirement on commercial banks, so banks do not act as financial intermediaries. Because banks issue deposits without costs, those deposits, like reserves, pay no nominal interest to households. There is no other government debt, so the central bank issues currency and reserves to finance government spending over and above income taxes (the government earns seignorage from both currency
and reserves). While the central bank sets the growth rate of nominal money to satisfy the government’s budget constraint, the composition of the money stock is determined by households—the central bank supplies currency on demand in exchange for reserves.\footnote{Possible extension: add more fully developed banking sector with fractional reserves and financial intermediation.}

According to equation (2), currency and deposits are substitutes in satisfying the cash-in-advance constraint with a constant elasticity of substitution, $\rho$. If $\rho = 1$, cash and deposits are perfect substitutes. $\psi$ can be thought of as measuring the different transactions costs of using currency and deposits. If $\psi > 1$, currency is more costly to use for transactions than deposits (e.g., there is a positive probability of being robbed of currency on the way to the mall).\footnote{At this point $\psi$ is a constant, but should be generalized to depend on the government’s setting of $\phi_\tau$.}

We assume that the effective income tax rate on households is a diminishing function of currency holdings. This assumption reflects the presumption that transactions using currency can be more easily shielded from tax authorities that non-anonymous checking accounts. We model tax revenues as

$$T_t = \tau_0 [y_t - \phi(b_t)y_t]^\tau_1,$$

where $0 < \tau_0 < 1, \tau_1 \geq 1$ and $\phi(b_t)$ is the fraction of total income not reported to the taxing authority, which we assume is positively related to currency holdings. $\tau_0$ and $\tau_1$ are parameters set by the government. If $\tau_1 > 1$, marginal tax rates rise with income; however, in our baseline model we assume $\tau_1 = 1$ to consider a simpler flat tax rate structure. Under this assumption, the household’s effective tax rate is

$$\frac{T_t}{y_t} = \tau_0 [1 - \phi(b_t)].$$

We suppose that $\phi(b_t)$ rises with currency holdings, but at a diminishing rate, and that the rate of unreported income lie between 0 and 1. Specifically, we assume that

$$\phi(b_t) = 1 - e^{\phi_\tau b_t}, \quad \phi_\tau > 0.$$  

Note that $\phi_\tau$ is the semi-elasticity of the effective tax rate with respect to currency balances. We assume that the government has some control over this elasticity. For example, government suppression of large denomination currency notes would in effect reduce the ‘productivity’ of cash in evading taxes, leading to a reduction in $\phi_\tau$. Such proposed policies are the focus of our welfare experiments.

We further assume that the household incorporates production decisions directly, subject to a Cobb-Douglas production function: $y_t = k_t^\alpha n_t^{1-\alpha}$. The government satisfies its budget
constraint and sets the nominal growth rate of money exogenously:

\[ g_t = \tau_0 e^{-\phi_t b_t} y_t + m_t - \frac{m_{t-1}}{1 + \pi_t} \]  

(7)

\[ M_t = (1 + \theta) M_{t-1} \]  

(8)

where \( \frac{M_t}{P_t} = m_t \) and \( P_t \) is the overall price level. Given these assumptions, the household’s asset accumulation constraint becomes

\[ m_t - \frac{m_{t-1}}{1 + \pi_t} = (1 - \tau_0 e^{-\phi_t b_t}) k_t^\alpha n_t^{1-\alpha} - c_t - [k_{t+1} - (1 - \delta) k_t]. \]  

(9)

Equilibrium in this model depends on households maximizing lifetime utility subject to their cash-in-advance and asset accumulation constraints, and subject to the government satisfying its budget constraint and constant money growth rate. The model determines the paths of consumption, employment, currency, deposits, the capital stock, and one variable or parameter that ensure the government’s budget constraint holds. The inflation is also determined as the growth rate of the total money stock, determined by the government. The equilibrium conditions for this model are given in the appendix. In our preliminary analysis, we consider only the model’s long-run steady-state.

3 Calibration and welfare analysis

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
<th>Target/Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \beta )</td>
<td>0.98</td>
<td>Discount factor</td>
<td>2% Annual risk-free interest rate</td>
</tr>
<tr>
<td>( \gamma )</td>
<td>8</td>
<td>Disutility of labor</td>
<td>1/3 of time worked in steady state</td>
</tr>
<tr>
<td>( \chi )</td>
<td>1</td>
<td>Inverse of Frisch</td>
<td></td>
</tr>
<tr>
<td>( \theta )</td>
<td>0.02</td>
<td>Steady state inflation</td>
<td></td>
</tr>
<tr>
<td>( \tau )</td>
<td>0.25</td>
<td>Statutory income tax rate</td>
<td></td>
</tr>
<tr>
<td>( \phi_\tau )</td>
<td>0.1</td>
<td>Tax rate / semi-elasticity of money</td>
<td></td>
</tr>
<tr>
<td>( \rho )</td>
<td>0.7</td>
<td>CES between money and deposits</td>
<td></td>
</tr>
<tr>
<td>( \psi )</td>
<td>1.05</td>
<td>Weight on deposits</td>
<td></td>
</tr>
</tbody>
</table>

To analyze the model and solve for its steady state. We take a period to be one year. Baseline parameter values are reported in 1. Figure 1 shows that, as the government reduces the effectiveness of currency for tax evasion, output falls: the elimination of banknotes increases the effective tax rate, and therefore reduces the supply of labor and capital inputs.
in the steady-state. This is a pure ‘supply-side’ effect. Holding the statutory tax rate and seignorage revenue constant (recall that money is assumed to grow at a constant rate), government spending rises and tax revenues rise. The reduction in output would be mitigated if government spending enhanced the productivity of labor and capital.

We perform a simple welfare analysis by computing the value of the representative household’s lifetime utility function in the steady-state. We consider two policy experiments. In the first, we allow $\phi_r$ to vary holding statutory tax rates fixed and the money growth rate fixed. Thus, government spending must adjust to the extent that the parameter change affects tax revenues. In the second experiment, we hold government spending fixed as a proportion of total income; in this case, the tax rate must adjust to balance the government’s budget. Figure 2 reports the results. As $\phi_r$ falls, welfare falls in the first case: this result is not surprising since output falls and the increase in government spending has no direct effect on utility or productivity. In the second case, welfare also declines with currency suppression, but at a much slower rate. The reason is that the statutory tax rate adjustment mitigates the effects on the effective tax rate and output.
In Figure 3 the same exercise is performed but this time for different values of $\psi$, keeping $\phi_r$ constant at its baseline value.
4 Conclusion
References


