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# DOES MONETARY POLICY HAVE EXPANSIONARY BIAS WITH EXTERNAL WEALTH?*

Satoko Takamatsu

*Graduate School of Economics, Hitotsubashi University*
*Kunitachi, Tokyo 186-8601, Japan*
takamatu@econ.hit-u.ac.jp

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## *Abstract*

This paper investigates how the accumulation of external wealth affects a monetary policy. We demonstrate that though an expansionary bias emerges in a monetary policy, a fiscal method can eliminate such a bias.

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## I. *Introduction*

Whether or not a monetary authority has an incentive for inflation has been the subject of extensive literature. For example, the market power of monopolists imposes markups on their product prices and induces policymakers to correct this distortion. The short term trade-off between inflation and output, if any, might induce a central banker to resort to an expansionary policy. Moreover, in an open economy, when goods have closer substitutes within a country than across countries, the monopoly power of the nation as a whole in the world market will lead to its exploitation by the government.

Beyond these factors, this paper examines the effects of external wealth on the incentives of policymakers. We determine that though a monetary authority is motivated to implement a more expansionary policy, the possibility of a sales taxation can nullify such incentives.

The intuitive explanation of our finding is as follows. When a country is a net creditor at the international level, its residents are not required to work extremely hard. A monetary authority that oversees both the utility from consumption and the disutility from labor supply implements the expansionary policy, and residents experience even higher consumption by working harder. As a measure to eliminate such a monetary incentive, we entrust the fiscal policy to attain an optimal level of economic activity, by introducing sales tax.

The findings of this paper are related to the following literature. Corsetti and Pesenti (2001) showed that, with the producer-currency-pricing environment, the assumptions of Cobb--Douglas Consumption indexes and a zero initial nonmonetary wealth always balance

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the current account. We relax the latter assumption and leave the current account imbalanced in subsequent periods. With regard to the corrective tax, Rotemberg and Woodford (1997, 1999) proposed a method to eliminate markups resulting from the monopoly in a closed-economy setting. In addition to such a market power, Corsetti and Pesenti (2001, 2005) find the inflationary bias in an open-economy model with sticky prices. A method to nullify such incentives was developed by Benigno and Benigno (2003), and Galí and Monacelli (2005). This paper replicates all of these features and finds that, beyond these factors, further adjustment to tax/subsidy is required when the external wealth is not zero.

The structure of this paper is as follows. In section II, we present the model framework. In section III, we solve the model for monopolistically competitive equilibrium in a closed-form. Section IV describes the problems of the monetary authorities. In section V, we describe the tax policy. Section VI concludes the paper.

## II. *The Analytical Framework*

The world consists of two countries, which are symmetric, except with respect to their capital account positions. We refer to these countries as the home and foreign countries. All agents in the private sector are consumer-producers, who we refer to as yeomen. Each yeoman produces a differentiated good using his or her own labor, specializes in the production of a single differentiated good, and is the only producer of that good. Production is demand determined and because of markups over product prices, production levels would be below the Pareto-optimal levels in the absence of active government intervention. Moreover, prices would depart from the ex-post efficient levels because yeomen are supposed to set their product prices one period in advance. Yeomen inelastically supply products. All goods are tradable.

### 1. Yeoman

The lifetime utility function of a home yeoman of type $h \in [0, n]$ at time $t$ is given by the following equation. $E_t$ denotes the mathematical expectation conditional on information held at time $t$.

$$U_t^h \equiv E_t \sum_{s=t}^{\infty} \beta^{s-t} \left\{ \log C_s^h - \frac{\Phi}{2} (L_s^h)^2 \right\}$$

where $0 < \beta < 1$. $C_t$ represents the overall consumption. Individuals supply labor to produce their own goods and $L_t$ denotes hours worked by this yeoman. The coefficient $\Phi$ is constant.

The overall consumption, $C_t$, includes the bundle of home consumption goods $C_{H,t}$ and the bundle of foreign consumption goods $C_{F,t}$. The home (foreign) commodity aggregate $C_{H,t}$ ($C_{F,t}$) comprises the differentiated goods $C_{h',t}$ ($C_{f,t}$).

$$C_t^h \equiv \left( \frac{C_{H,t}^h}{n} \right)^n \left( \frac{C_{F,t}^h}{1-n} \right)^{1-n}$$

$$C_{H,t}^h \equiv \left[ \left( \frac{1}{n} \right)^{\frac{1}{\theta}} \int_0^n C_{h',t}^{h\ \frac{\theta-1}{\theta}} dh' \right]^{\frac{\theta}{\theta-1}}, \quad C_{F,t}^h \equiv \left[ \left( \frac{1}{1-n} \right)^{\frac{1}{\theta}} \int_n^1 C_{f,t}^{h\ \frac{\theta-1}{\theta}} df \right]^{\frac{\theta}{\theta-1}}$$

where $0<n<1$, $\theta>1$. Price indexes are defined as the minimal cost of purchasing one of the corresponding consumption bundles:

$$P_t = P_{H,t}{}^{n}\, P_{F,t}{}^{1-n}$$

$$P_{H,t} = \left[\frac{1}{n}\int_0^n P_{h',t}{}^{1-\theta} dh'\right]^{\frac{1}{1-\theta}},\quad P_{F,t} = \left[\frac{1}{1-n}\int_n^1 P_{f,t}{}^{1-\theta} df\right]^{\frac{1}{1-\theta}}.$$

$P_t$ is used for $C_t$; $P_{H,t}$, for $C_{H,t}$; and $P_{F,t}$, for $C_{F,t}$. $P_{f,t}$ represents the home currency price of the foreign good $f$, while $P^*_{f,t}$ is its foreign currency price. Given these settings, individual $h$'s demand for good $h'$ or $f$ and the corresponding aggregates $C^h_{H,t}$ or $C^h_{F,t}$ are

$$C^h_{H,t} = n\left[\frac{P_{H,t}}{P_t}\right]^{-1} C^h_t$$

$$C^h_{F,t} = (1-n)\left[\frac{P_{F,t}}{P_t}\right]^{-1} C^h_t$$

$$C^h_{h',t} = \frac{1}{n}\left[\frac{P_{h',t}}{P_{H,t}}\right]^{-\theta} C^h_{H,t}$$

$$C^h_{f,t} = \frac{1}{1-n}\left[\frac{P_{f,t}}{P_{F,t}}\right]^{-\theta} C^h_{F,t}.$$

Foreign economic agents inhabit the interval $(n, 1]$ and have identical preferences. The symbol "*" is used to represent foreign variables; thus variables with a "*" symbol indicate prices in foreign currency, consumption by foreign residents, and so on. For later use, let us denote the world variable as a weighted average of domestic and foreign variables. For a general variable $x_t$, we express that $x^W_t \equiv nx_t + (1-n)x^*_t$.

A home (foreign) economic agent of type $h$ $(f)$ produces a single differentiated good $h$ $(f)$. Yeomen in the same country have identical technology. The production function of home yeomen $h$ is

$$Y^h_t = A_t L^h_t \tag{1}$$

where $L^h_t$ denotes $h$'s labor input. $A_t$ is a country-specific productivity shock. Foreign economic agents have identical technology, except that the realization of foreign shock, namely $A^*_t$, may differ ex-post.

The home yeoman's budget constraint is given by

$$\int_0^n \int_j q(j)_{t+1} B(j)^h_{h',t+1} dj dh' + S_t \int_n^1 \int_j q(j)^*_{t+1} B(j)^h_{f,t+1} dj df + P_t C^h_t + T_t$$
$$= \int_0^n B^h_{h',t} dh' + S_t \int_n^1 B^h_{f,t} df + (1-\tau_t) P_{h,t} Y^h_t,\ \forall t \tag{2}$$

where $S_t$ expresses the home currency price of foreign currency; $P_{h,t}Y^h_t$, the nominal income derived from yeoman $h$'s production activity, which is taxed at the rate $\tau_t$; and $T_t$ represents a nominal lump-sum tax per capita imposed by the domestic government.

A complete set of one-period nominal state contingent claims is available period by period. Economic agents hold home and foreign private claims denominated in issuers' currencies. $B(j)_{h',t+1}$ represents a nominal contingent claim that pays the amount $B(j)_{h',t+1}$ in the home currency only when the state $j$ is realized at time $t+1$. It is sold at time $t$ for the price $q(j)_{t+1}$. Similarly, $B(j)_{f,t+1}$ represents the foreign currency denominated contingent claim. We assume perfect capital mobility and that the international claims arbitrage is perfect; thus, all commodity trade imbalances are financed by the international lending market. $B^{h'}_{h,t+1}$ denotes net lending by (or borrowing from) the home yeoman $h$', which is positive for borrowing from $h$' and negative for lending, and $B^{h'}_{h,t+1}=-B^{h}_{h',t+1}$ by definition. Similarly, $B^{f}_{h,t+1}$ denotes the net capital account position of the foreign yeoman $f$. In the following, we assume that, without loss of generality, the home country is a net creditor.

Since these functions and budget constraints apply to all home yeomen, henceforth, we omit the superscript $h$. The same applies for foreign yeomen. Parameters are the same in both countries.

### 2. Government/Fiscal-Monetary Authority

The home government levies lump-sum taxes $T_t$ and sales taxes at the rate of $\tau_t$, on its residents, and the home government's budget constraint is balanced in every period. When the home residents' per capita income from production is $P_{h,t}Y_t$, the home government's budget constraint is as follows:

$$\tau_t P_{h,t} Y_t + T_t = 0. \tag{3}$$

The foreign authority faces a similar constraint. In the foreign country, the sales tax rate is $\tau^*_t$ and the lump-sum taxes are $T^*_t$.

We assume that each monetary authority controls the level of nominal expenditure of its residents, $\chi_t \equiv P_t C_t$ or $\chi^*_t \equiv P^*_t C^*_t$. We interpret this ability as monetary control in a unit velocity version of the quantity theory of money, though we are not explicit about the money demand in this paper.

## III. *The Yeoman's Optimization Problem*

At time $t$, individuals choose the consumption level $C_t$, and home and foreign claims holdings $B(j)_{h,t+1}$ and $B(j)_{f,t+1}$. Let $\pi(j)$ denote the probability that the state of nature is $j$ in the next period. Home agents face the following problem:[1]

$$\max_{B(j)_{h,t+1},\, B(j)_{f,t+1}} U_t \quad \text{s.t.} \quad (2)$$

and nonnegativity constraints on consumption $C_t \geq 0$. The first-order necessary conditions for the home yeoman's problem yields

[1] For the intertemporal budget constraint, we require transversality conditions.

$$q(j)_{t+1} = \frac{\beta\pi(j)\dfrac{1}{P(j)_{t+1}C(j)_{t+1}}}{\dfrac{1}{P_t C_t}} \tag{4}$$

$$q(j)^*_{t+1} = \frac{\beta\pi(j)\dfrac{S(j)_{t+1}}{P(j)_{t+1}C(j)_{t+1}}}{\dfrac{S_t}{P_t C_t}} \tag{5}$$

for all $t < \infty$. Eq. (4) represents the price of contingent claim $j$ in the home country at time $t$, and eq. (5) presents the home resident's evaluation of the price of foreign contingent claim $j$ at time $t$. Similarly, as a result of the foreign yeoman's optimization, the price of foreign contingent claim $j$ is derived as follows:

$$q(j)^*_{t+1} = \frac{\beta\pi(j)\dfrac{1}{P(j)^*_{t+1}C(j)^*_{t+1}}}{\dfrac{1}{P^*_t C^*_t}}. \tag{6}$$

Home yeomen set product prices in the domestic market $P_{h,t}$ in the currency of their own country in advance at time $t-1$. They set foreign currency prices $P^*_{h,t}$ so that $P^*_{h,t} = P_{h,t}/S_t$, once $S_t$ is revealed at time $t$. Since the total supply $Y_t$ is determined by the world demand $C^W_{h,t}$ under monopolistic competition, the goods market clearing implies

$$Y_t = C^W_{h,t}. \tag{7}$$

Consequently, the representative home agent faces the following problem at time $t-1$:

$$\max_{P_{h,t}} U_{t-1} \quad \text{s.t.} \quad (1), (2), (7).$$

The first-order necessary conditions for $P_h$ is as follows:

$$(1-\tau_t)(1-\theta)E_{t-1}\left\{\frac{\partial U(C_t)/\partial C}{P_t} Y_t\right\} + \Phi\theta E_{t-1}\left\{\frac{1}{P_{h,t}} L_t^2\right\} = 0 \tag{8}$$

Prices in each period are set to equate the marginal disutility associated with an additional unit of labor input to the marginal utility from consumption. Eq. (8) indicates that the expected utility from work effort is expressed as follows:

$$\frac{\Phi}{2} E_{t-1}\{L_t^2\} = \frac{(1-\tau_t)(\theta-1)}{2\theta} E_{t-1}\left\{\frac{\partial U(C_t)}{\partial C} C_t^W\right\}$$
$$= \frac{(1-\tau_t)(\theta-1)}{2\theta}\left(n + (1-n)\frac{C^*_t}{C_t}\right)$$

This equation indicates that a creditor country experiences lower work effort on average, because the need to further enhance the income is low. The last term $(n + (1-n)C^*_t/C_t)$

reflects the world aggregate demand relative to home consumption, which provides a factor that the government potentially wants to target.

Analogous expressions apply to foreign goods.

## 1. The Equilibrium

In this subsection, we derive allocations and prices when yeomen consider governmental policies to be exogenous.

Given the sequences for productivity, $\{A_s, A_s^*\}_{s=t}^{\infty}$, government policy $\{\chi_s, \chi_s^*, \tau_s, \tau_s^*, T_s, T_s^*\}_{s=t}^{\infty}$, and the initial value $C_0/C_0^*$, the equilibrium is a set of allocations $\{B_{F,s+1}, C_s, C_s^*, Y_s, Y_s^*\}_{s=t}^{\infty}$, and prices $\{q(j)_{s+1}, q(j)_{s+1}^*, S_s, P_{h,s}, P_{h,s}^*, P_{f,s}, P_{f,s}^*, P_s, P_s^*\}_{s=t}^{\infty}$ that satisfy the yeoman's optimization problems, yeoman's cost minimization when purchasing one unit of consumption goods, the budget constraints of the yeoman and government, and goods market clearing condition for all $t$, in each country.

Exchange Rate

Substituting product prices into the price indices yields the following:

$$P_t = P_{H,t}^n (P_{F,t} S_t)^{1-n}$$

$$P_t^* = \left(\frac{P_{H,t}}{S_t}\right)^n P_{F,t}^{1-n}.$$

These equations indicate that $S_t = P_t/P_t^* = (\chi_t/\chi_t^*)(C_t^*/C_t)$. Thus, the determinants of exchange rate can be decomposed into three parts: the monetary policy in the home country, the monetary policy in the foreign country, and the consumption ratio.

When complete nominal asset markets exist, the levels of consumption are proportional across countries provided the law of one price applies. To observe this, combine eqs. (5) and (6), and derive the following:

$$\frac{S(j)_{t+1} P(j)_{t+1}^* C(j)_{t+1}^*}{P(j)_{t+1} C(j)_{t+1}} = \frac{S_t P_t^* C_t^*}{P_t C_t}.$$

Note that we have assumed that the probability assigned to state $j$, $\pi(j)$, and the subjective discount factor $\beta$ are identical for all agents. Let $C_0/C_0^* \equiv \alpha > 0$. By substituting recursively, we can derive the risk-sharing condition for every time period $t$ following the first one, as follows:

$$\frac{S(j)_{t+1} P(j)_{t+1}^* C(j)_{t+1}^*}{P(j)_{t+1} C(j)_{t+1}} = \frac{S_0 P_0^*}{P_0} \frac{1}{\alpha}$$

for all $j$, $t \geq 0$. When the law of one price holds, this condition is reduced to

$$\frac{C(j)_t}{C(j)_t^*} = \alpha$$

for all $j$, $t \geq 0$. This indicates that the consumption ratio is constant over time.

Consumption and Work Effort

Consumption per capita and individual work effort can be written as functions of exogenous and predetermined endogenous variables.

$$C_t = \left( \frac{\frac{\theta-1}{\Phi\theta}}{n+(1-n)\frac{1}{\alpha}} \right)^{\frac{1}{2}} \left( \frac{(1-\tau_t)\chi_t^2}{E_{t-1}\left\{ \left( \frac{\chi_t}{A_t} \right)^2 \right\}} \right)^{\frac{n}{2}} \left( \frac{(1-\tau_t^*)\chi_t^{*2}}{E_{t-1}\left\{ \left( \frac{\chi_t^*}{A_t^*} \right)^2 \right\}} \alpha \right)^{\frac{1-n}{2}}$$

$$C_t^* = \left( \frac{\frac{\theta-1}{\Phi\theta}}{n\alpha+1-n} \right)^{\frac{1}{2}} \left( \frac{(1-\tau_t)\chi_t^2}{E_{t-1}\left\{ \left( \frac{\chi_t}{A_t} \right)^2 \right\}} \frac{1}{\alpha} \right)^{\frac{n}{2}} \left( \frac{(1-\tau_t^*)\chi_t^{*2}}{E_{t-1}\left\{ \left( \frac{\chi_t^*}{A_t^*} \right)^2 \right\}} \right)^{\frac{1-n}{2}}$$

$$L_t = \left( \frac{\theta-1}{\Phi\theta} \left( n+(1-n)\frac{1}{\alpha} \right) \frac{(1-\tau_t)\left( \frac{\chi_t}{A_t} \right)^2}{E_{t-1}\left\{ \left( \frac{\chi_t}{A_t} \right)^2 \right\}} \right)^{\frac{1}{2}}$$

$$L_t^* = \left( \frac{\theta-1}{\Phi\theta} (n\alpha+1-n) \frac{(1-\tau_t^*)\left( \frac{\chi_t^*}{A_t^*} \right)^2}{E_{t-1}\left\{ \left( \frac{\chi_t^*}{A_t^*} \right)^2 \right\}} \right)^{\frac{1}{2}}$$

for $t < \infty$. Since the consumption preference is in logarithmic form, policy variables are separable from the world aggregate demand relative to the consumption in the creditor (home) country. In turn, the disutility from labor supply directly reflects $C^W/C$.

## IV. *Monetary Policy*

In this section, we describe the monetary authority's optimization problem and their optimal policies $\chi_t$ and $\chi_t^*$. We assume each policymaker to be benevolent and as maximizing his/her own residents' consumption- and leisure-related utilities and ignore the direct utilities from liquidity services. Policies are chosen at time $t$, subject to the restriction that behaviors in private sectors are given by the equilibrium in Section 3.1. The private sector forms expectations before policy makers set monetary rules, and therefore, authorities have an incentive to re-optimize their policies in the following period.

The optimal policies must satisfy the following:

$$n - \frac{1-\tau_t}{\frac{\theta}{\theta-1}\frac{1}{n+(1-n)\frac{1}{\alpha}}} \frac{\left(\frac{\chi_t}{A_t}\right)^2}{E_{t-1}\left\{\left(\frac{\chi_t}{A_t}\right)^2\right\}} = 0,$$

$$(1-n) - \frac{1-\tau_t^*}{\frac{\theta}{\theta-1}\frac{1}{n\alpha+(1-n)}} \frac{\left(\frac{\chi_t^*}{A_t^*}\right)^2}{E_{t-1}\left\{\left(\frac{\chi_t^*}{A_t^*}\right)^2\right\}} = 0$$

for all $t < \infty$. These policy functions show that if the fiscal policy did not eliminate monopolistic distortions, we would expect expansionary as well as contractionary incentives to monetary authorities. In particular, $\alpha$ provides the expansionary incentive for the monetary policy in the home country in order to offset the private sector's incentive for low production. On the other hand, the reduction in production tax $\tau_t$ limits surprise expansion.

We consider a method to eliminate these monetary incentives in the next section.

## V. *Corrective Tax Policies*

We consider a situation where the sales tax policy is aimed to correct distortions and externalities. Rotemberg and Woodford (1997, 1999) proposed the single-country models wherein tax-subsidy policies cancel out monopolistic distortions. In a two-country model, other factors emerge that would be subject to governmental control.

We assume that the fiscal authorities minimize the distortions that exist in the allocation under flexible prices:

$$C_t = \left(\frac{\frac{\theta-1}{\Phi\theta}}{n+(1-n)\frac{1}{\alpha}}\right)^{\frac{1}{2}} ((1-\tau_t)A_t^2)^{\frac{n}{2}} ((1-\tau_t^*)A_t^{*2}\alpha)^{\frac{1-n}{2}}$$

$$C_t^* = \left(\frac{\frac{\theta-1}{\Phi\theta}}{n\alpha+1-n}\right)^{\frac{1}{2}} \left((1-\tau_t)A_t^2\frac{1}{\alpha}\right)^{\frac{n}{2}} ((1-\tau_t^*)A_t^{*2})^{\frac{1-n}{2}}$$

$$L_t = \left(\frac{\theta-1}{\Phi\theta}\left(n+(1-n)\frac{1}{\alpha}\right)(1-\tau_t)\right)^{\frac{1}{2}}$$

$$L_t^* = \left(\frac{\theta-1}{\Phi\theta}(n\alpha+1-n)(1-\tau_t^*)\right)^{\frac{1}{2}}$$

for $t < \infty$.

Each policy maker determines its tax rule independently to maximize the utility of the residents of its own country, given the private sector's allocation and pricing rules. In such a case, the government sets the tax rate so that

$$\tau_t = 1 - \frac{\theta}{\theta-1}\frac{n}{n+(1-n)\dfrac{1}{\alpha}} \quad \text{or} \quad \tau_t^* = 1 - \frac{\theta}{\theta-1}\frac{1-n}{n\alpha+(1-n)}$$

for all $t < \infty$. Since the parameters on the right-hand side are assumed to be time invariant, these tax rates are also constant over time. The policy in the home country depends on three factors.

First, a government offsets the markup $\theta/(\theta-1)$ by decreasing the tax rate.[2] Second, as the share of home goods $n$ increases, the fiscal tax increases.[3] Third, in a country whose external wealth position is one of surplus, the tax policy tends to be low.

There are three factors that derive the policy in the foreign country. As in the home country, $\theta/(\theta-1)$ reduces the tax rate and $(1-n)$ increases it. In addition, $1/(n\alpha+1-n)$ also increases the tax rate because the foreign country is a net debtor.

Given these rates of sales taxes, the inflationary/deflationary bias disappears in equilibrium.

## VI. *Concluding Remarks*

In this paper, we have demonstrated that, in the presence of external wealth, labor supply is not high enough, from the viewpoint of the government in a creditor country. This motivates the monetary authority to create a surprise expansion.

The sales tax is effective to eliminate such an ill effect of wealth, both under a sticky-price as well as flexible-price economy. Under a sticky-price environment, the optimal sales tax works to eliminate a bias of discretionary monetary policy.

For future research, we plan to relax the complete market assumption. An indebted country may well have an incentive to utilize an unexpected expansion to devalue their external debt, which would be possible if the pricing of bonds is not efficient. This is not possible in our model because the international financial market is complete and the purchasing power parity holds, and thus, the risk of the real value of external debt is shared across countries. The alteration of a government's incentive under an incomplete market and the implications for national welfare in light of the financial structure are interesting issues.

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[2] The factor, $\theta/(\theta-1)$, in the tax rate corresponds to the optimal tax rate in Rotemberg and Woodford (1997, 1999).

[3] The factor, $n$, corresponds to the adjustment made by Benigno and Benigno (2003), and Galí and Monacelli (2005).

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