1 The Welfare Costs of Inflation: US and Brazil

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Presentation at PUC-Rio,

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September 27, 2001

2 Introduction

This presentation is based on three papers by Joe Yoshino:

i) A Restatement of the Welfare Costs of Inflation: The Waste of Scarce Resources in the Manufacturing, Households and Banking Sectors;

ii) The Social Costs of Inflation: The Misallocation of Resources in the Manufacturing and Households Sectors; and

iii) The Brazilian Inflationary Waste of Resources

3 Stylized Facts:US and Brazil

Estimations of Welfare Costs of Inflation				
Reference	**Type of Model**	**Monetary Aggregate**	**Country**	**Welfare Costs/GDP %**
Bailey (1956)	Partial equilibrium	Monetary Base	Austria	0.0377
Bailey (1956)	Partial equilibrium	Monetary Base	Germany	0.0704
Bailey (1956)	Partial equilibrium	Monetary Base	Greece	0.0572
Bailey (1956)	Partial equilibrium	Monetary Base	Hungary	0.159
Bailey (1956)	Partial equilibrium	Monetary Base	Hungary	0.046
Bailey (1956)	Partial equilibrium	Monetary Base	Polonia	0.0346
Bailey (1956)	Partial equilibrium	Monetary Base	Russia	0.0085
Black, MacKlen and Poloz (1993)	Partial equilibrium		US	3.04-3.14
Braun (1994)	Partial equilibrium	M1	US	0.92
Cooley and Hansey (1991)	General equilibrium	M1	US	0.36
Den Haan (1990)	General equilibrium		US	4.6
Dotsey and Ireland (1994)	General equilibrium		US	1.73
Eckstein and Leideman (1992)	General equilibrium	Monetary Base	US	0.85-1.93
Fisher (1981)	Partial equilibrium		US	0.3
Gilman (1993)	General equilibrium	M1	US	2.19
Gilman (1995)	Partial equilibrium	M1	US	0.349
Ireland (1994)	General equilibrium		US	0.62
Lucas (1993)	General equilibrium	M1	US	1.64
Lucas (2000)	General equilibrium	M1	US	1
McCallum (1989)	Partial equilibrium		US	0.28
Pastore (1995)	Partial equilibrium	Monetary Base	Brazil	0.1-0.45
Yoshino (2001a)	General equilibrium	Monetary Base and credit	US	7.6

Source: Polato and Fava, 2001

Table 1. Estimations of Welfare Costs of Inflation

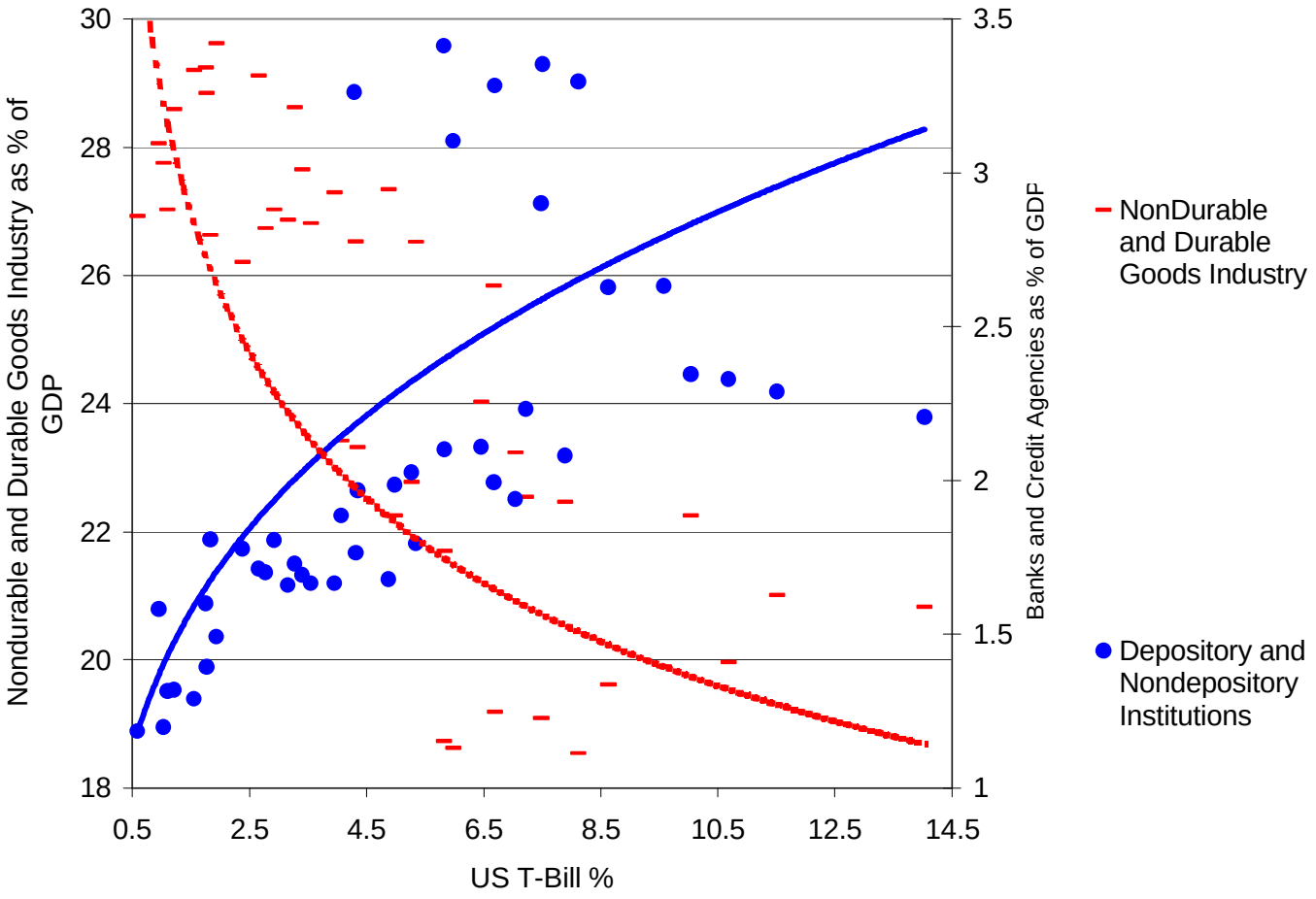

Figure IA. The Welfare Costs of Inflation. The Loss of Consumption Goods and Overbanking. US: 1947-99

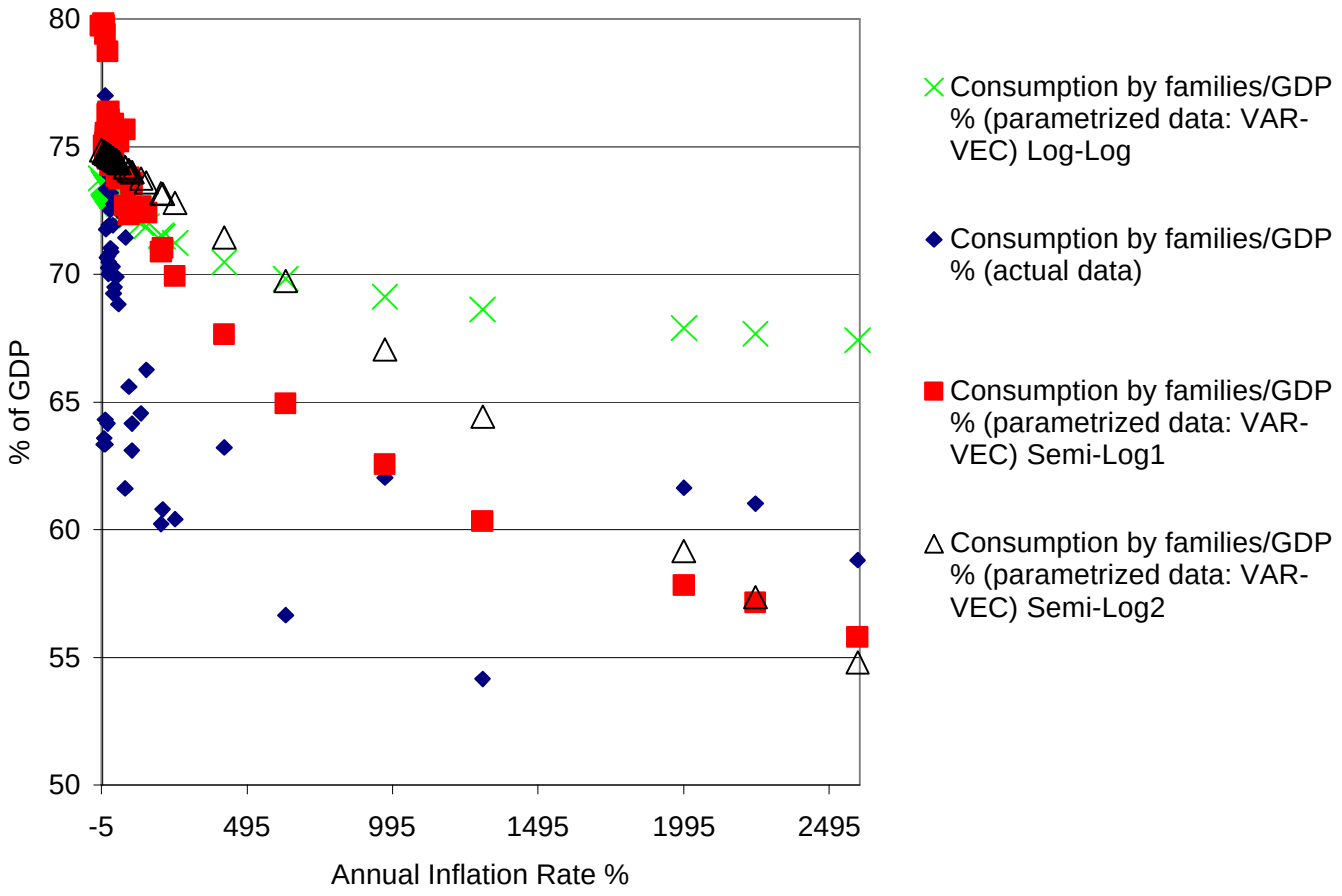

Figure 1. Range for the Loss of Consumption Goods by Families. Brazil: 1948-2000

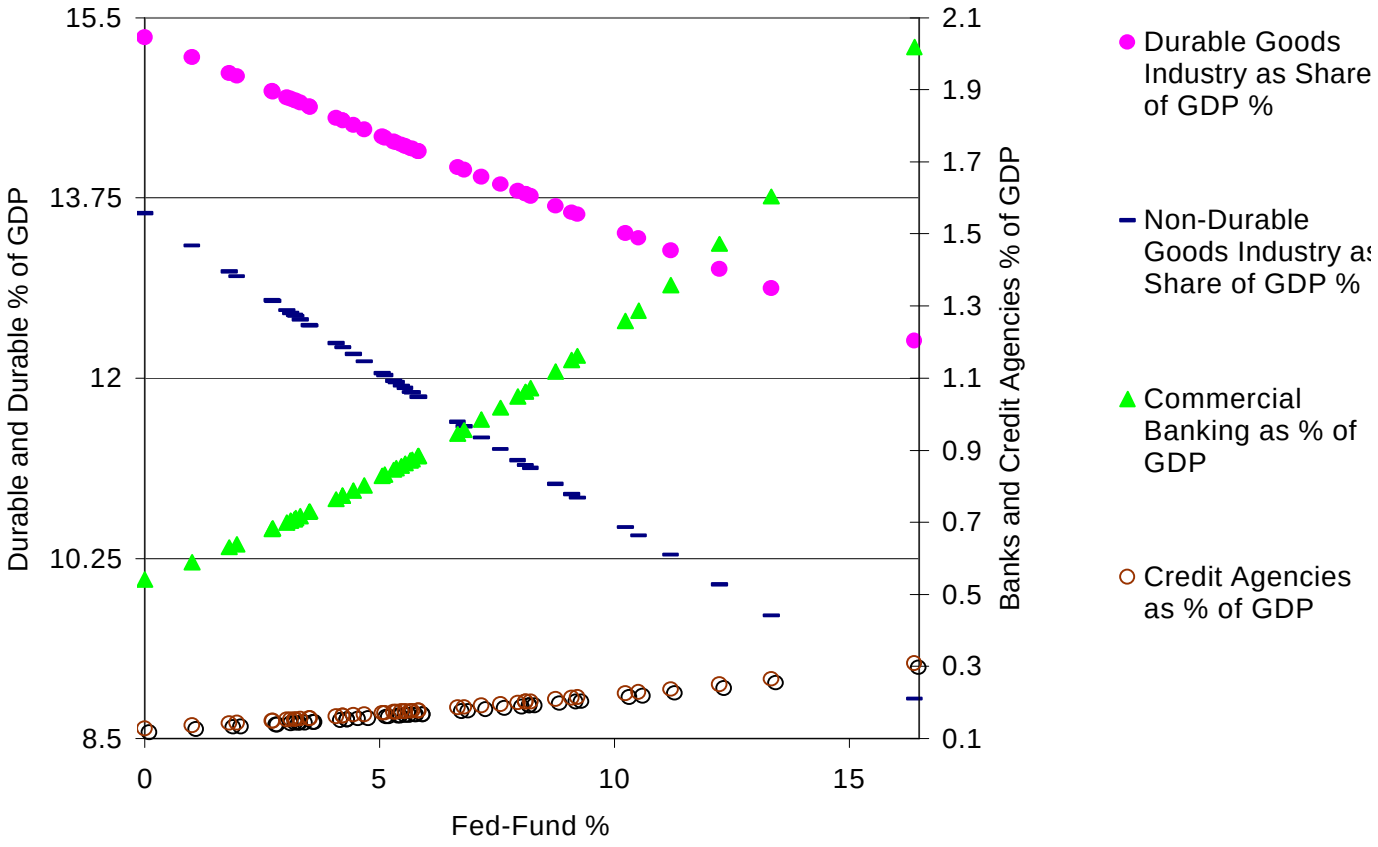

Figure 2. The Fitted Values (VAR-VEC) for Consumption Goods and Banking. US: 1955-98

Based on figure 1 for Brazil, figure 2 shows the Brazilian social costs as function of inflation rates. For the Brazilian Monetary history, the maximum loss of consumption were between 6.3% of GDP and 23.9% of GDP, which happened in the year 1993. We will try latter on alternative measures to verify the consistency of this range.

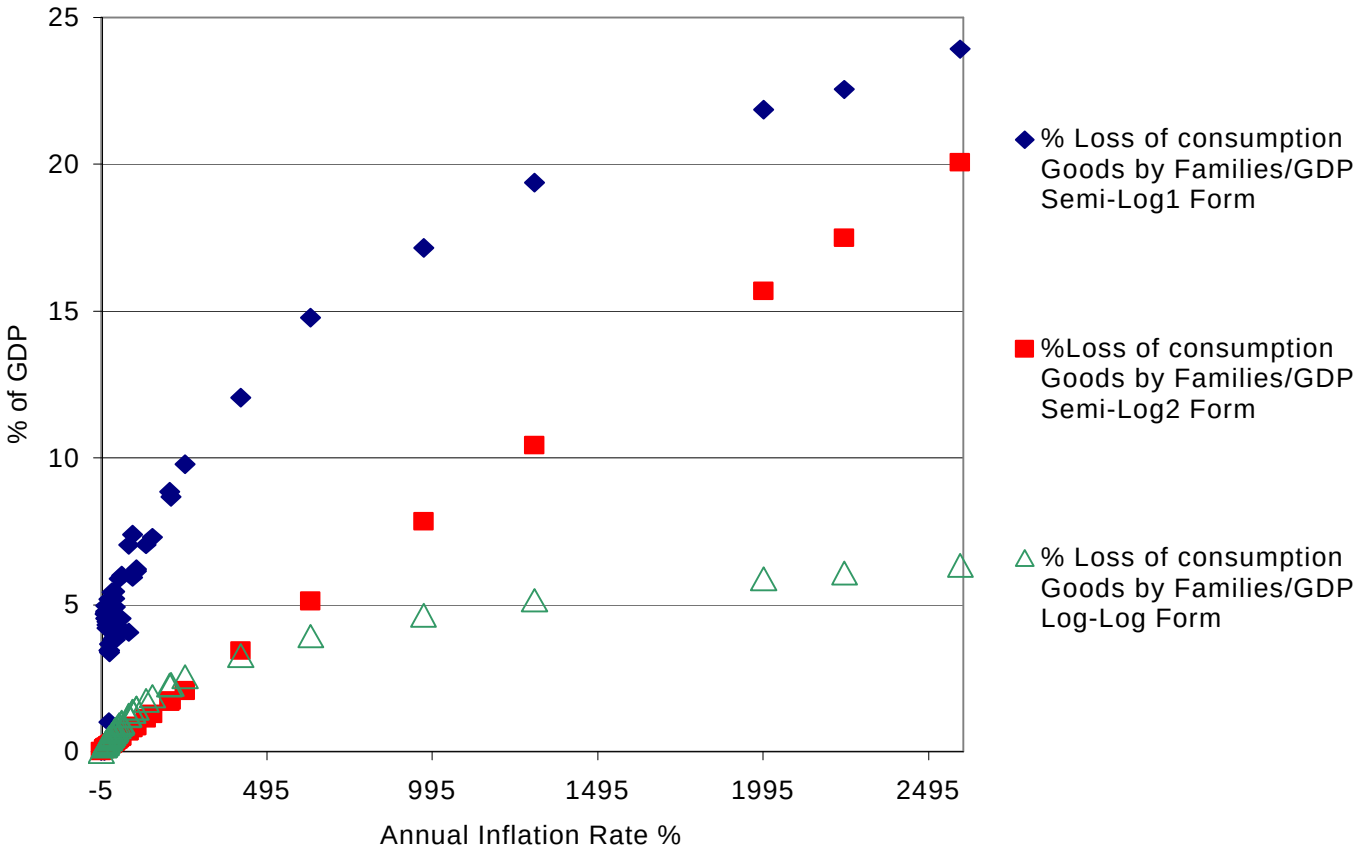

Figure 2. Range for the Loss of Consumption Goods/GDP; Brazil: 1948-2000

The welfare costs of inflation when the inflation rates goes from -5% per year (Friedman optimum) to 2590% in the year 1990 in terms of the percentage change in the utility level due to consumption goods foregone varies from 0.6% ($\alpha = 1.5$ and $Log - Log$ demand) to 43.7% ($\alpha = 0$ and semi-log demand). See figure 3 below.

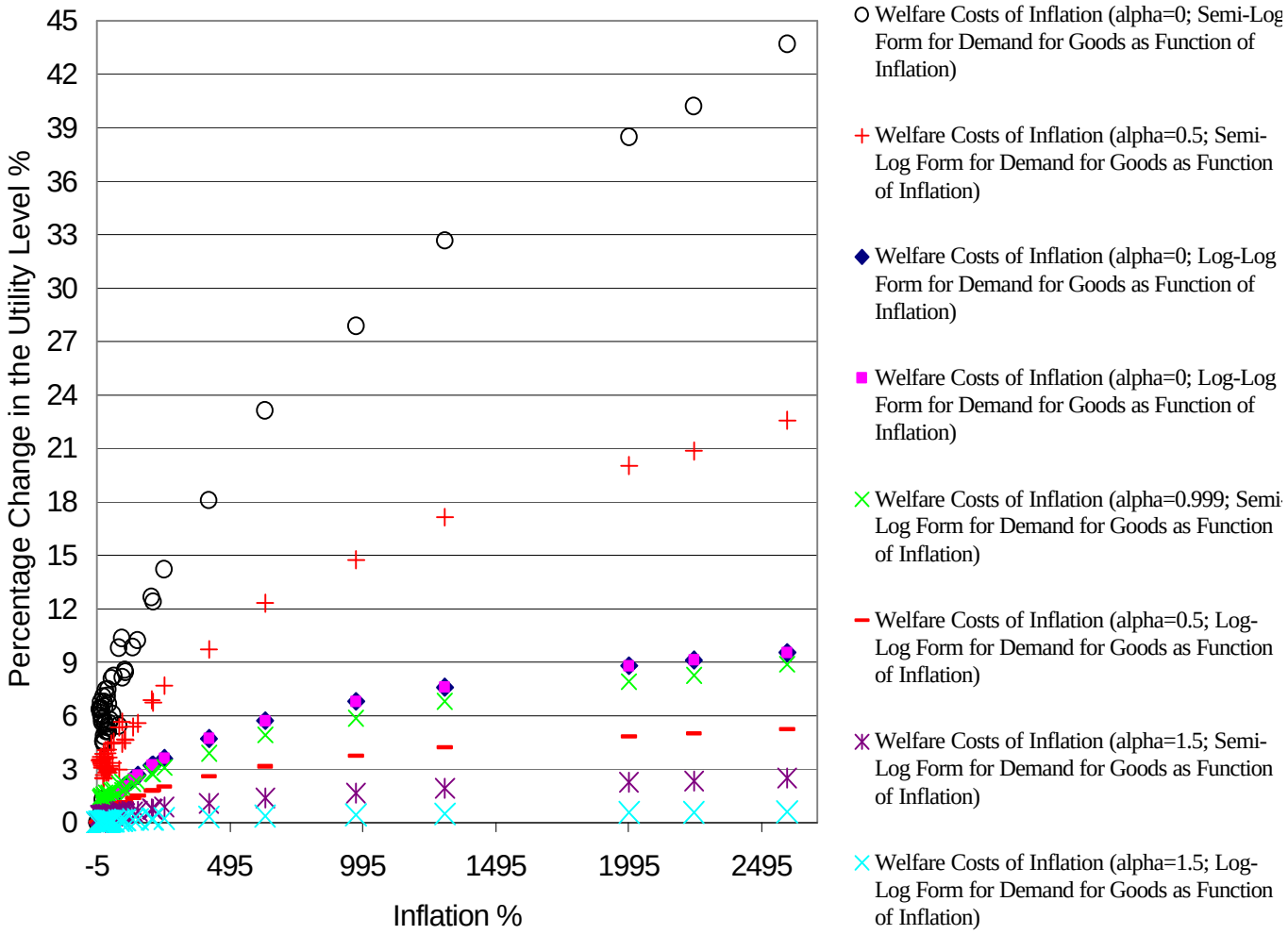

Figure 3. Range for the Welfare Costs of Inflation. Brazil: 1948-2000

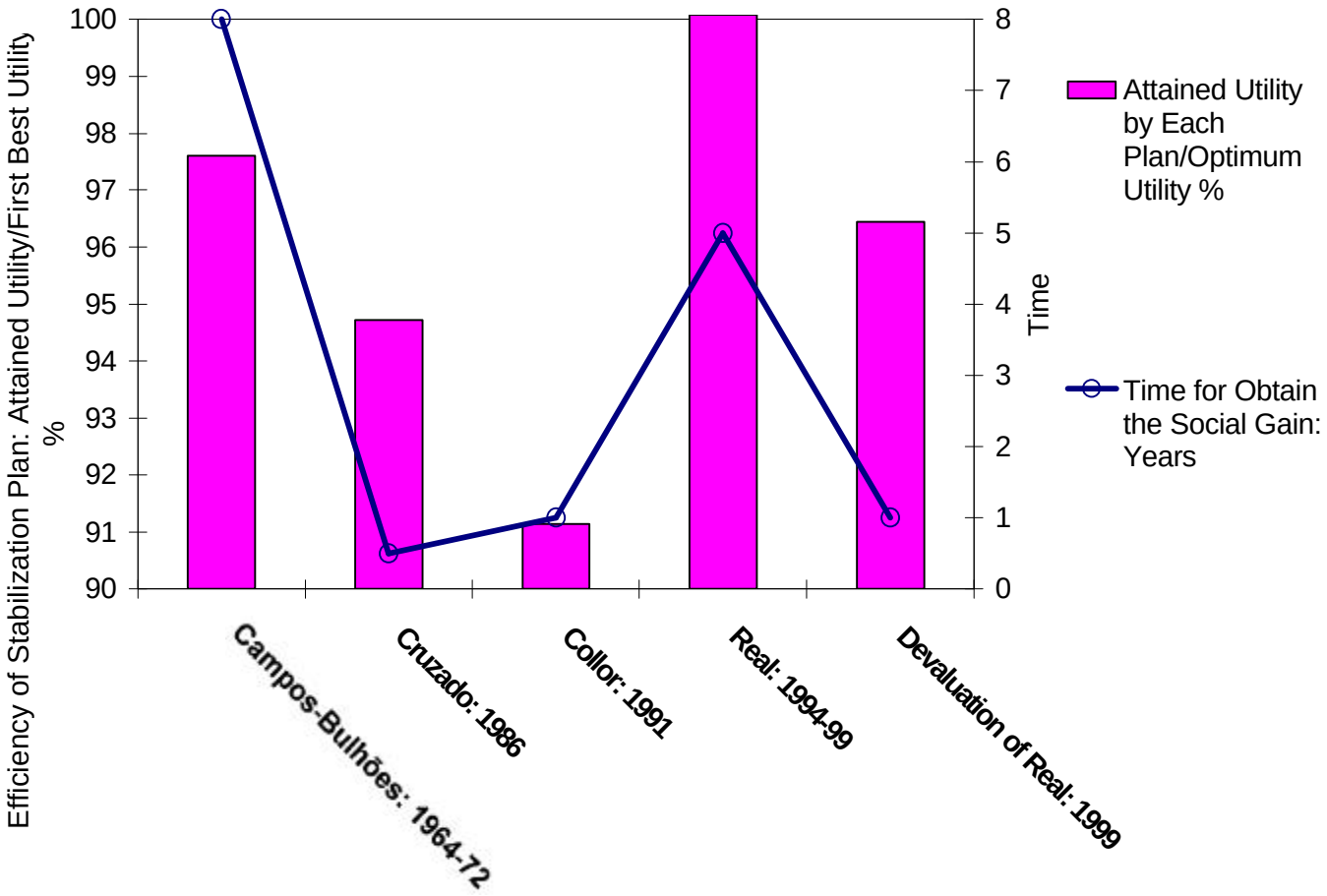

Figure 4. The Efficiency of Brazilian Stabilization Plans

Channels for the Misallocation of Resources: US and Brazil

i) Overbanking (Misallocation of resources in the Banking Industry);

ii) Firm Float Time (Misallocation of resources in the Manufacturing Industry); and

iii) Household Shopping Time (Misallocation of resources in the Household Sector).

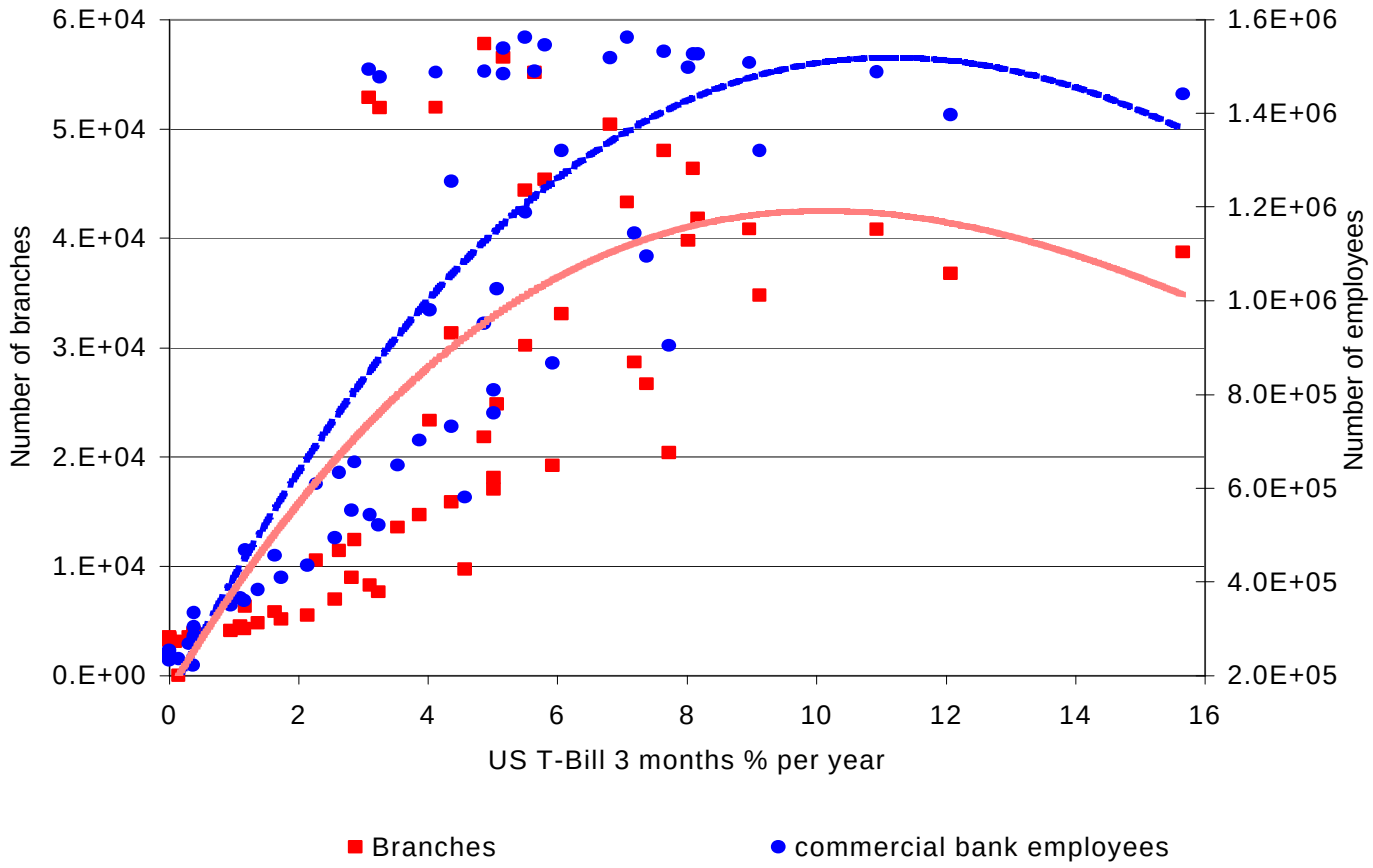

Figure 4. Inflation and the Real Resources Allocated in the Banking Industry. US: 1934-99

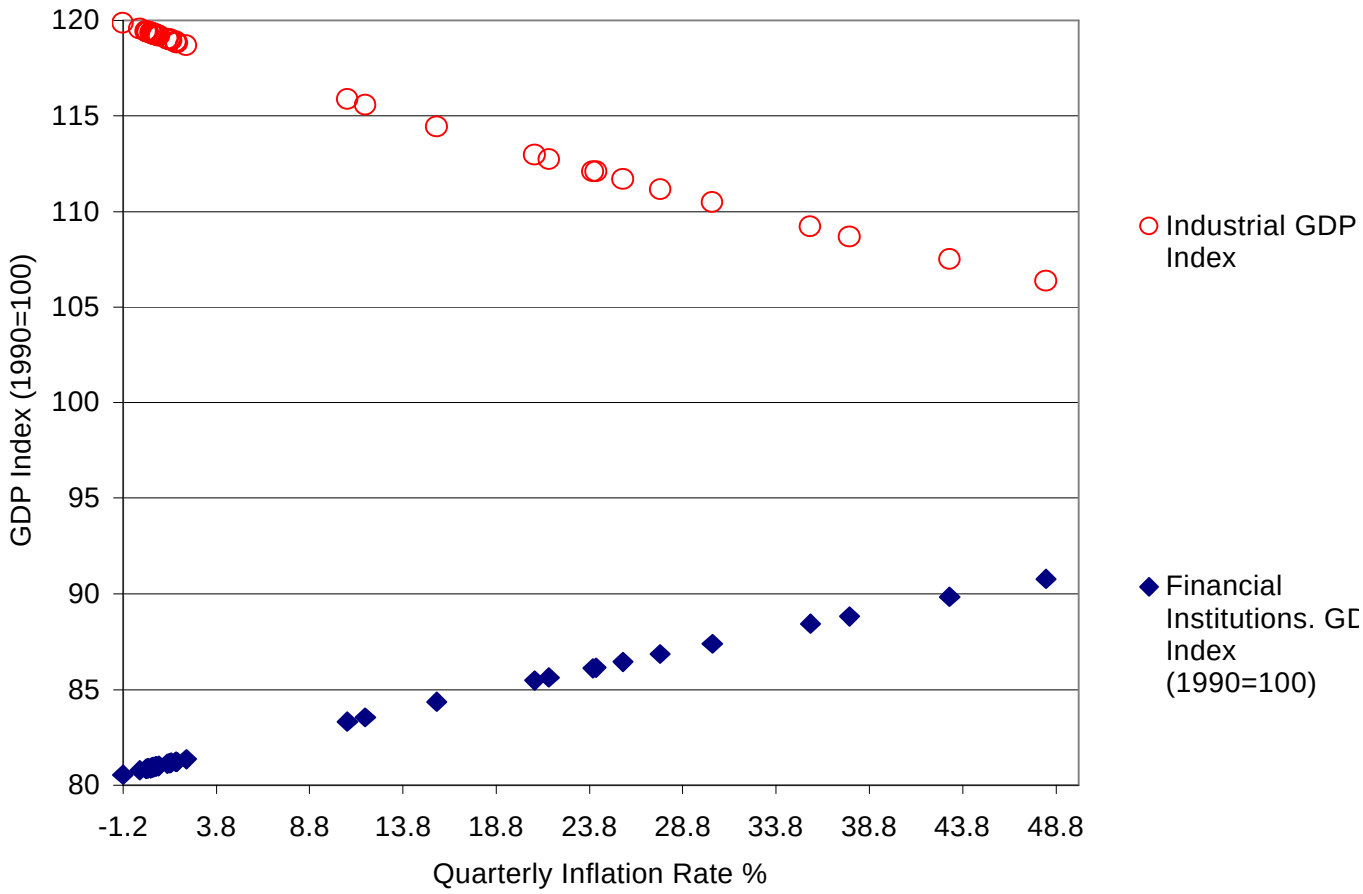

Figure 5. The Shrinking Manufacturing Industry and the Overbanking Phenomenon (Hypertrophy). Brazil: 1986:I-2001:II

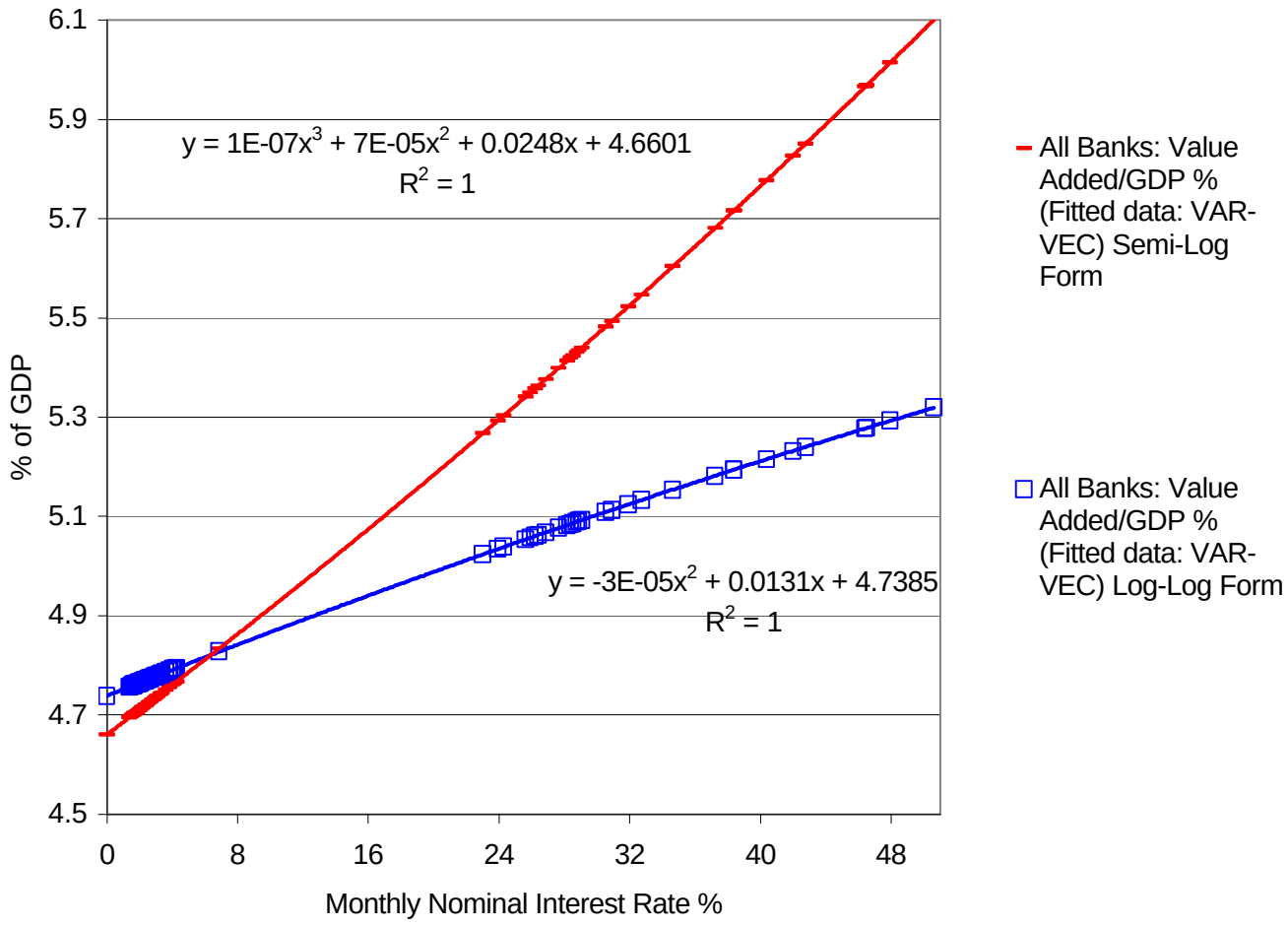

Figure 7. The Brazilian Bank Value Added. 1992:1 1999:12

Pearson correlations	US T-BILL	total employment	administrative support including clerical	precision production, craft and repair	other services except protective	Breakdown of total labor force Year 1994
total employment	0.36	1.00	.435(*)	.459(*)	0.05	100 %
Professional and technicial	0.05	.451(*)	-0.16	-0.01	-.456(*)	10.1
Managers and Administrators except farm	-0.21	0.24	-0.39	-.644(**)	-.681(**)	12.4
Sales	-0.18	0.18	-0.33	-.691(**)	-.607(**)	5.2
administrative support including clerical	.666(**)	.435(*)	1.00	.606(**)	.551(**)	11.3
precision production, craft and repair	.499(*)	.459(*)	.606(**)	1.00	.554(**)	14.1
machine operators, assemblers and inspectors	0.28	0.24	.450(*)	.769(**)	.612(**)	34.5
transport equipment operatives	0.40	0.21	.605(**)	.517(*)	.708(**)	3.9
handlers, equipment cleaners, helpers, and laborers	-0.33	0.19	-0.35	-.722(**)	-.609(**)	6.8
other services except protective	.431(*)	0.05	.551(**)	.554(**)	1.00	1.6

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table 1. Inflation and Occupational Employment in the Non-Durable Gooods. US: 1972-94

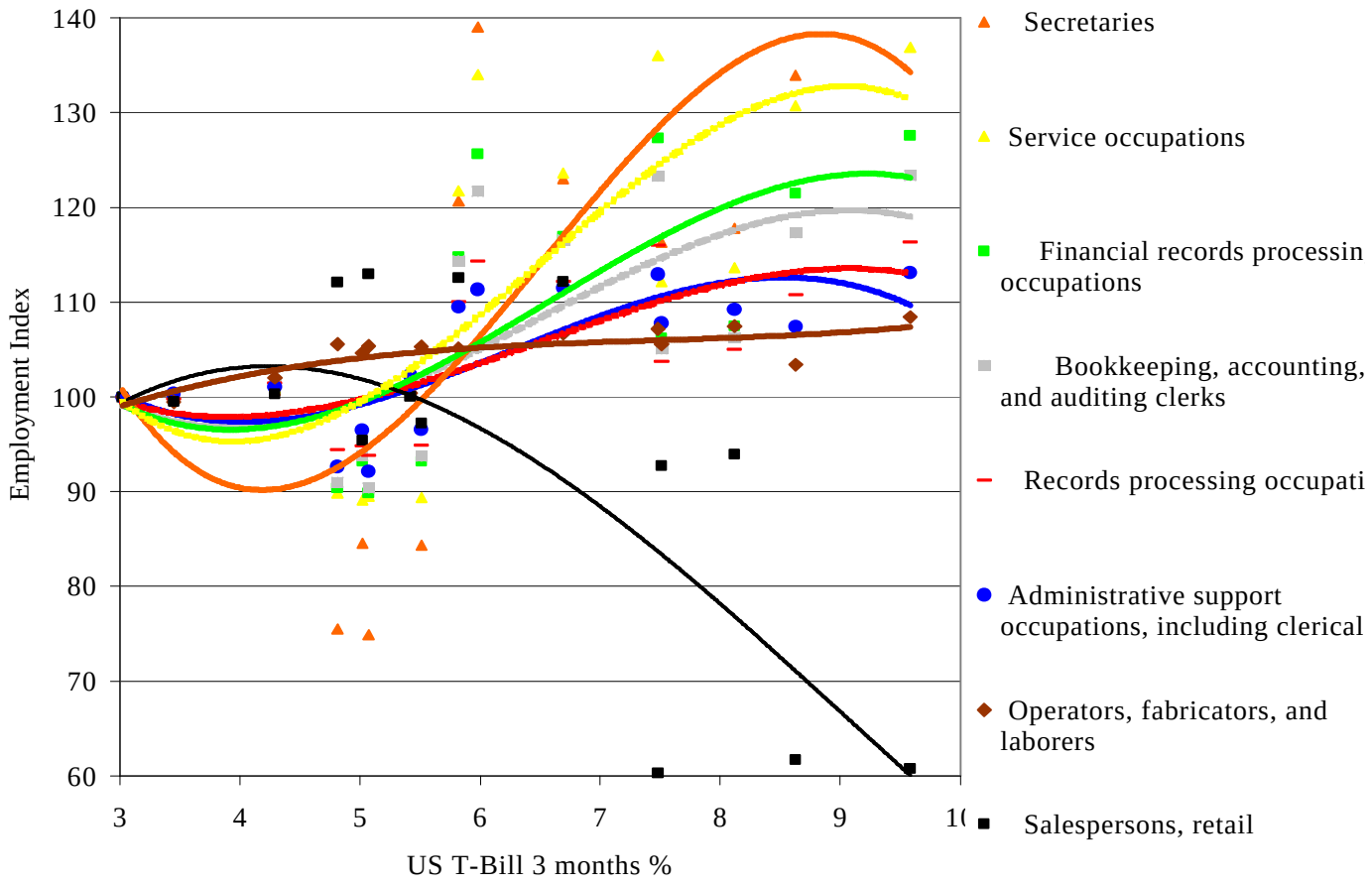

Figure 1. The Float Labor in the Manufacturing Industry. US: 1983-98

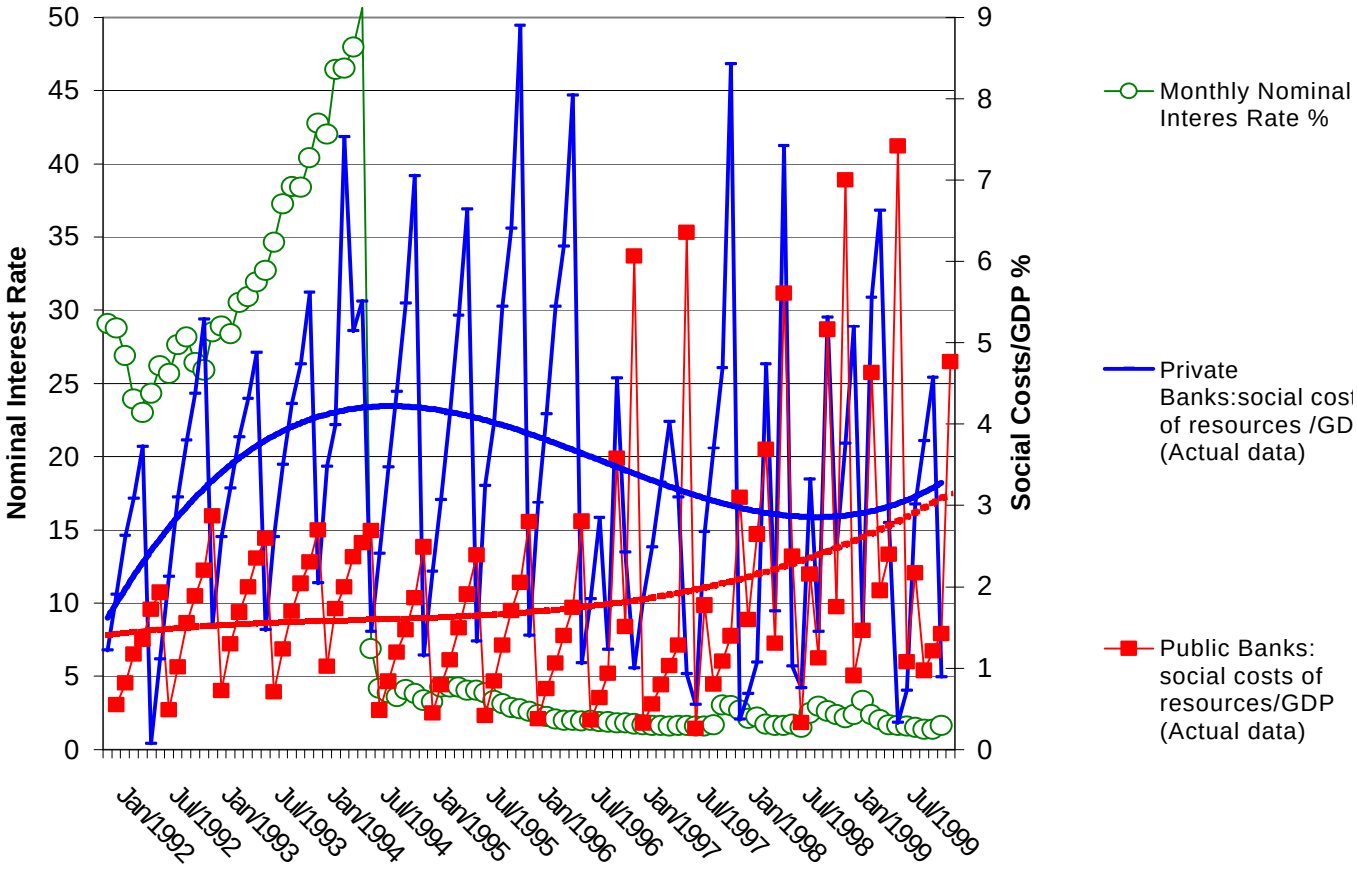

Figure 8. The Allocation of Scarce Resources by Types of Banks. Brazil 1992:1 1999:12

4 The Model

$$\sum_{t=0}^{\infty}(1+\rho)^{-t}U(C_t) \tag{1}$$

$$n_t^c = 1 - n_t^b - n_t^{\Upsilon} \tag{2}$$

$$C_t = n_t^c \tag{3}$$

$$C_t = H[m_t, d_t, l_t, s_t].n_t^{\Upsilon} \tag{4}$$

$$\frac{n_t^c}{n_t^{\Upsilon}} = H[m_t, d_t, l_t, s_t] \tag{5}$$

$$\frac{\partial H}{\partial m_t} > 0; \frac{\partial H}{\partial d_t} > 0; \frac{\partial H}{\partial l_t} > 0; \frac{\partial H}{\partial s_t} > 0 \tag{6}$$

$$n_t^b = B[d_t, l_t^b, Z_t, s_t] \tag{7}$$

$$Z_t = \alpha_t . d_t \tag{8}$$

$$l_t^b = (1 - \alpha_t) . d_t \tag{9}$$

$$n_t^b = B[d_t, (1 - \alpha_t) . d_t, \alpha_t . d_t, s_t] \tag{10}$$

$$\chi_t = (m_{t+1} + \alpha_{t+1}.d_{t+1}).(1 + \pi_{t+1}) - m_t - \alpha_t.d_t \tag{11}$$

$$\tau_t = \frac{T_t}{P_t} = (1 + i_t^l).\frac{L_{t-1}^b}{P_t} - (1 + i_t^d).\frac{D_{t-1}}{P_t} - \frac{L_t^b}{P_t} + \frac{D_t}{P_t} - \frac{W_t}{P_t}.n_t^b + \frac{\Psi_t}{P_t}.s_t = 0$$

$$\begin{aligned} \tau_t &= (1 + r_t^l).l_{t-1}^b - (1 + r_t^d).d_{t-1} \\ &\quad -l_t^b + d_t - w_t.n_t^b + \phi_t.s_t \end{aligned} \tag{12}$$

Where: $(1 + i_t^l) = (1 + r_t^l).(1 + \pi_t)$;

$(1 + i_t^d) = (1 + r_t^d).(1 + \pi_t)$; $\frac{W_t}{P_t} = w_t$;

$\phi_t = \frac{\Psi_t}{P_t}$; $\pi_t = \frac{P_t - P_{t-1}}{P_{t-1}}$

(r_t^l) is the real interest rate charged on loans; (r_t^d) is the real interest rate paid on deposits. $(1+i_t) = (1+\rho)(1+\pi_t)$ and ρ is the marginal rate of time preference.

Please note that is ρ exogenous, while the banking real interest rates (r_t^l, r_t^d) are endogenous

$$\begin{gathered}\tau_t = [r_t^l.(1-\alpha_{t-1}) - r_t^d].d_{t-1} \\ -\alpha_{t-1}.d_{t-1} + \alpha_t.d_t \\ -w_t.B[d_t, (1-\alpha_t).d_t, \alpha_t.d_t, s_t] + \\ \phi_t.s_t\end{gathered} \tag{13}$$

$$\begin{gathered}-w_t.n_t^b - \tau_t + (1+r_t^l).l_{t-1} - (1+r_t^d).d_{t-1} - l_t + d_t \\ +\phi_t.s_t - \chi_t + (1+\pi_{t+1}).(m_{t+1} + \alpha_{t+1}.d_{t+1}) \\ -m_t - \alpha_t.d_t = 0\end{gathered}$$

$$
\begin{aligned}
&-w_t.\{1-n_t^{\Upsilon}[1+H(m_t,d_t,l_t,s_t)]\}-\tau_t+ \\
&(1+r_t^l).l_{t-1}-(1+r_t^d).d_{t-1} \\
&-l_t+d_t+\phi_t.s_t-\chi_t+ \\
&(1+\pi_{t+1}).(m_{t+1}+\alpha_{t+1}.d_{t+1}) \\
&-m_t-\alpha_t.d_t=0
\end{aligned}
\tag{14}
$$

4.1 The Problem of Competitive Banks

Banks maximize their present values of the profits by choosing (d_t, s_t) The steady state first order conditions are

$$
\begin{aligned}
(1-\alpha).r^l+\alpha.\rho &= r^d \\
&\quad +(1+\rho).w.\frac{\partial n^b}{\partial d}
\end{aligned}
\tag{15}
$$

$$\phi = w.\frac{\partial n^b}{\partial s} \tag{16}$$

Where: $\frac{\partial n^b}{\partial d} = (1-\alpha).B_l + B_d + \alpha.B_z$

4.2 The Problem of Households

Max utility subject to budget constraint Choice variables: $n_t^{\Upsilon}, m_{t+1}, d_{t+1}, l_t, s_t$

We have the following steady state first order conditions

$$\pounds_{n_t^{\Upsilon}} : \lambda = -\frac{U_c.H}{w.(1+H)} \tag{17}$$

$$\pounds_{m_{t+1}} \quad and \quad \pounds_{n_t^{\Upsilon}} : w.\frac{H_{m_t}.n_t^{\Upsilon}}{H} = i \tag{18}$$

$$w\frac{\frac{\partial n^c}{\partial m_t}}{\frac{\partial n^c}{\partial n_t^{\Upsilon}}} = i$$

$$\pounds_{d_{t+1}}, \quad \pounds_{n_t^{\Upsilon}} : \frac{w.H_{d^h}.n_t^{\Upsilon}}{H} = i\alpha - \frac{r^d - \rho}{1+\rho} \tag{19}$$

$$\frac{w\frac{\partial n^c}{\partial d}}{\frac{\partial n^c}{\partial n_t^{\Upsilon}}} + \frac{r^d - \rho}{1+\rho} = i\alpha$$

$$\pounds_{s_t}, \quad \pounds_{n_t^\Upsilon} : w\frac{H_s.n_t^\Upsilon}{H} = \phi \tag{20}$$
$$w\frac{\frac{\partial c}{\partial s}}{\frac{\partial c}{\partial n_t^\Upsilon}} = \phi$$

$$\pounds_{l_t}, \pounds_{n_t^\Upsilon} : \frac{w.H_l.n_t^\Upsilon}{H} = \frac{r^l - \rho}{1+\rho} \tag{21}$$
$$w\frac{\frac{\partial n^c}{\partial l}}{\frac{\partial c}{\partial n_t^\Upsilon}} = \frac{r^l - \rho}{1+\rho}$$

Some of the equations above can be simplified. By using the homogeneity of B and H functions permit us the application of Euler's theorem.

$$n_t^b = B[d, l^b, Z, s] = d.B_d + l.B_l + Z.B_z + s.B_s \tag{22}$$

$$w.n^b = w.[B_d + \alpha.B_z + (1-\alpha)B_l].d + w.B_s.s \tag{23}$$

$$= \frac{[(1-\alpha).r^l - r^d + \alpha\rho]}{(1+\rho)}.d + \phi.s$$

$$= \frac{l.(r^l - \rho) - d.(r^d - \rho)}{(1+\rho)} + \phi.s$$

Equation 23 shows two ways to estimate the value of the scarce resources allocated in the commercial banking industry: i) by considering the LHS - bank expenditure on real resources according to the income statement; or ii) by using the budget constraint of banks.

Similarly for H(..) function of the non-financial private sector, we have

$$H[m, d, l, s] = m.H_m + d.H_d + l.H_l + s.H_s \tag{24}$$

$$w.n^{\Upsilon} = i.(m + \alpha.d) + l.\frac{r^l - \rho}{(1+\rho)} - d.\frac{r^d - \rho}{(1+\rho)} + \phi s \tag{25}$$

We derive next the welfare costs of inflation due to the resources misallocated in the banking industry and in the non-financial private sector. For this purpose, we consider the indirect utility function - maximum attained utility by using the optimal choices defined above and for an exogenous inflation rate. The total differentiation of the indirect utility function and by using the first order conditions above (envelope theorem), we have

$$\frac{dU}{-\lambda} = -d\tau + l.dr^l - d.dr^d + s.d\phi - d\chi + (m + \alpha.d).d\pi \tag{26}$$

Taking the integral , we have

$$\int_{i=0}^{i^*} \frac{dU}{-\lambda} = \left[\int_{r_0^l}^{r_1^l} l.dr^l - l(r_1^l).r_1^l + l(r_0^l).r_0^l\right] - \left[\int_{r_0^d}^{r_1^d} d.dr^d - d(r_1^d).r_1^d + d(r_0^d).r_0^d\right] + \int_{i=0}^{i^*}(m + \alpha.d).di - i^*.[m(i^*) + \alpha.d(i^*)] + \left[\int_{\phi_0}^{\phi_1} s.d\phi - \phi_1.s(\phi_1) + \phi_{0.}s(\phi_0)\right] + \left[w.n^b(i^*) - w.n^b(i=0)\right]$$

Where: $-\lambda > 0$ is the marginal utility of income

for a given $i = 0 \longrightarrow \begin{bmatrix} r_0^l \\ r_0^d \\ \phi_0 \end{bmatrix}$;

Similarly for $i = i^* > 0 \longrightarrow \begin{bmatrix} r_1^l \\ r_1^d \\ \phi_1 \end{bmatrix}$

Equation above defines the total welfare costs of inflation which is composed of:

i) Harberger triangle: deadweight loss in the market for credit: inside money

$$\left[\int_{r_0^l}^{r_1^l} l.dr^l - l(r_1^l).r_1^l + l(r_0^l).r_0^l\right]$$
$$+\left[\int_{r_1^d}^{r_0^d} d.dr^d - d(r_1^d).r_1^d + d(r_0^d).r_0^d\right]$$

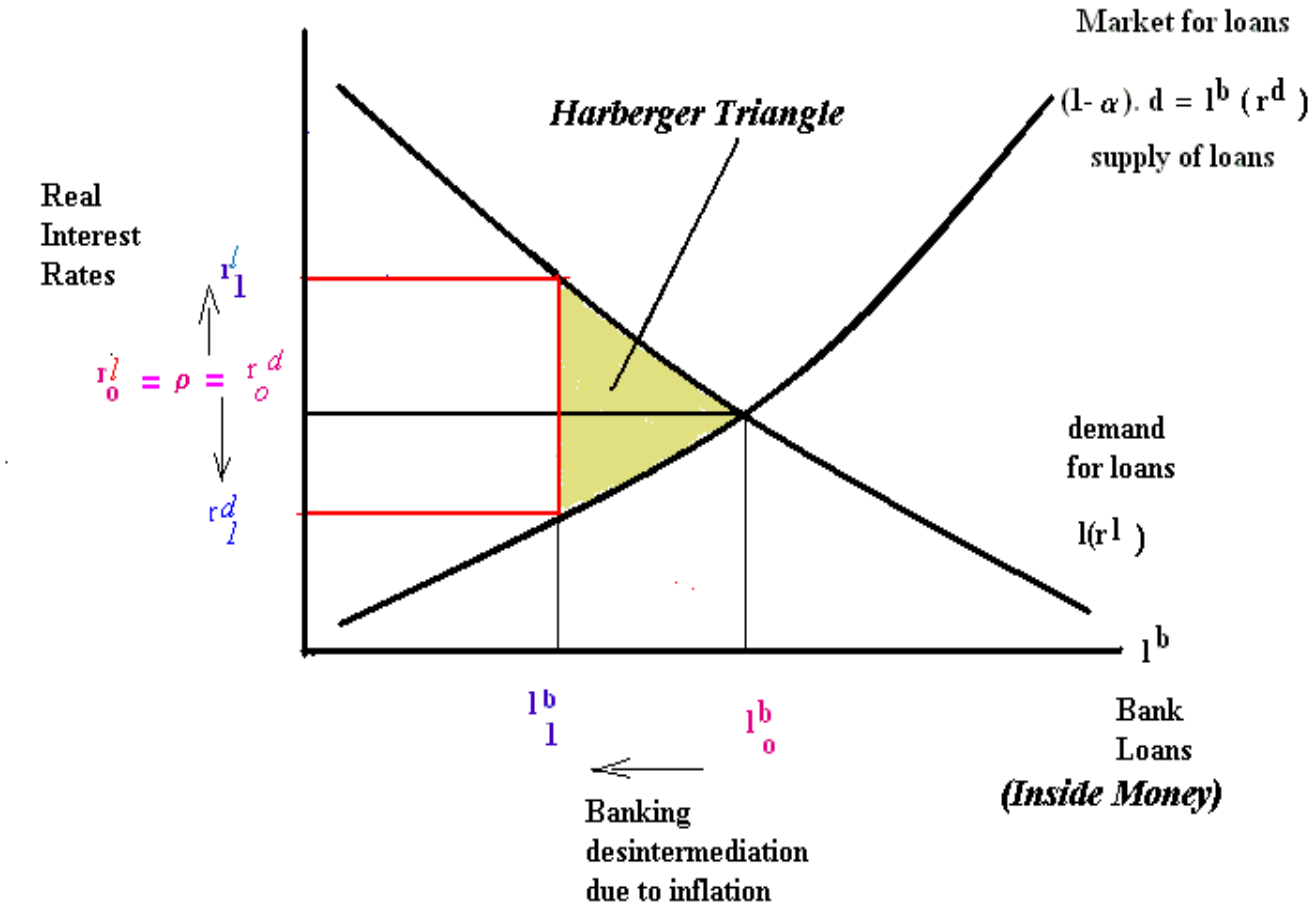

Figure 11. Harberger Distorting Triangle

ii) Bailey triangle under the demand for monetary base (outside money)

$$\int_{i=0}^{i^*}(m+\alpha.d).di - i^*.[m(i^*)+\alpha.d(i^*)]$$

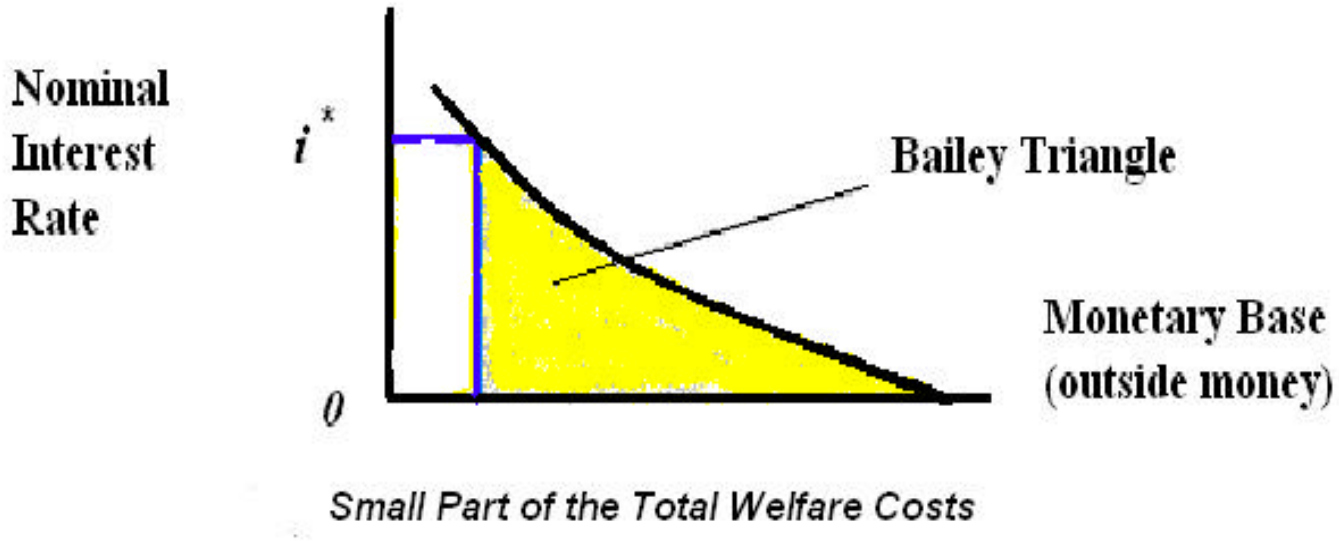

Figure 12. Bailey Distorting Triangle

iii) Deaweight loss in the market for bank services plus the change in the value of overbanking

$$+\left[\int_{\phi_0}^{\phi_1} s.d\phi - \phi_1.s(\phi_1) + \phi_0.s(\phi_0)\right]$$
$$+\left[w.n^b(i^*) - w.n^b(i=0)\right]$$

5 Estimation of the Welfare Costs of Inflation: US and Brazil

There are several approaches to estimate the welfare costs functions. For instance, we had according to the equations 23, 25 and 28 :

$$w.(1-n^c) = w.[n^b(i) + n_t^{\Upsilon}(i)] \tag{27}$$

$$w.n^b = \frac{l.(r^l-\rho) - d.(r^d-\rho)}{(1+\rho)} + \phi.s$$

$$w.n_t^{\Upsilon} = i.(m_t + \alpha.d) + [l.\frac{r^l-\rho}{(1+\rho)} - d.\frac{r^d-\rho}{(1+\rho)}] + \phi.s$$

$$\begin{aligned}\int_{i=0}^{i^*} \frac{dU}{-\lambda} &= \left[\int_{r_0^l}^{r_1^l} l.dr^l - l(r_1^l).r_1^l + l(r_0^l).r_0^l\right] \\ &\quad - \left[\int_{r_0^d}^{r_1^d} d.dr^d - d(r_1^d).r_1^d + d(r_0^d).r_0^d\right] \\ &\quad + \int_{i=0}^{i^*} (m + \alpha.d).di - i^*.[m(i^*) + \alpha.d(i^*)] \\ &\quad + \left[\int_{\phi_0}^{\phi_1} s.d\phi - \phi_1.s(\phi_1) + \phi_{0.}s(\phi_0)\right] \\ &\quad + \left[w.n^b(i^*) - w.n^b(i=0)\right]\end{aligned}$$

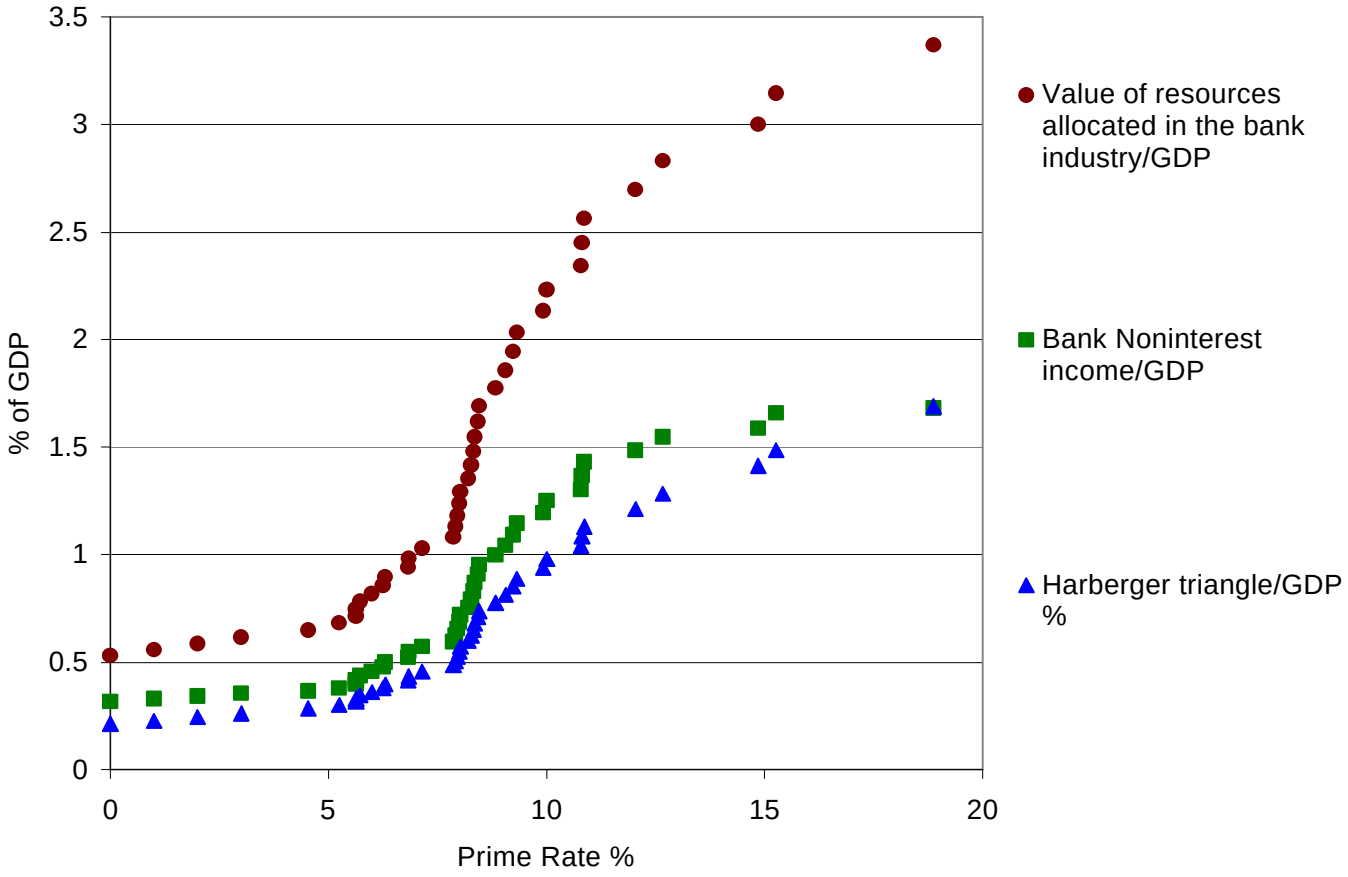

Figure 8. Overbanking and Components. US: 1965-99

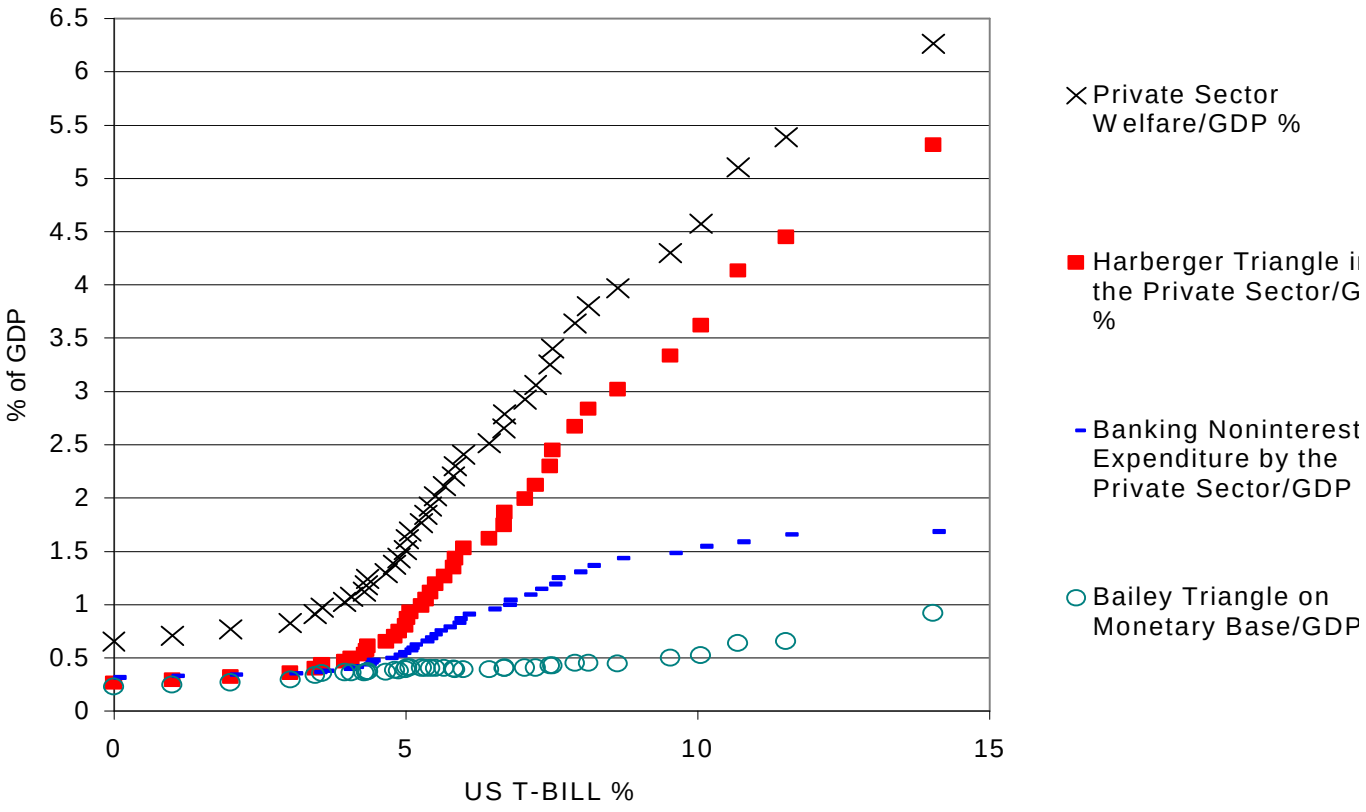

Figure 9A. The Welfare Costs of Resources Wasted in the Private Sector. US: 1965-99

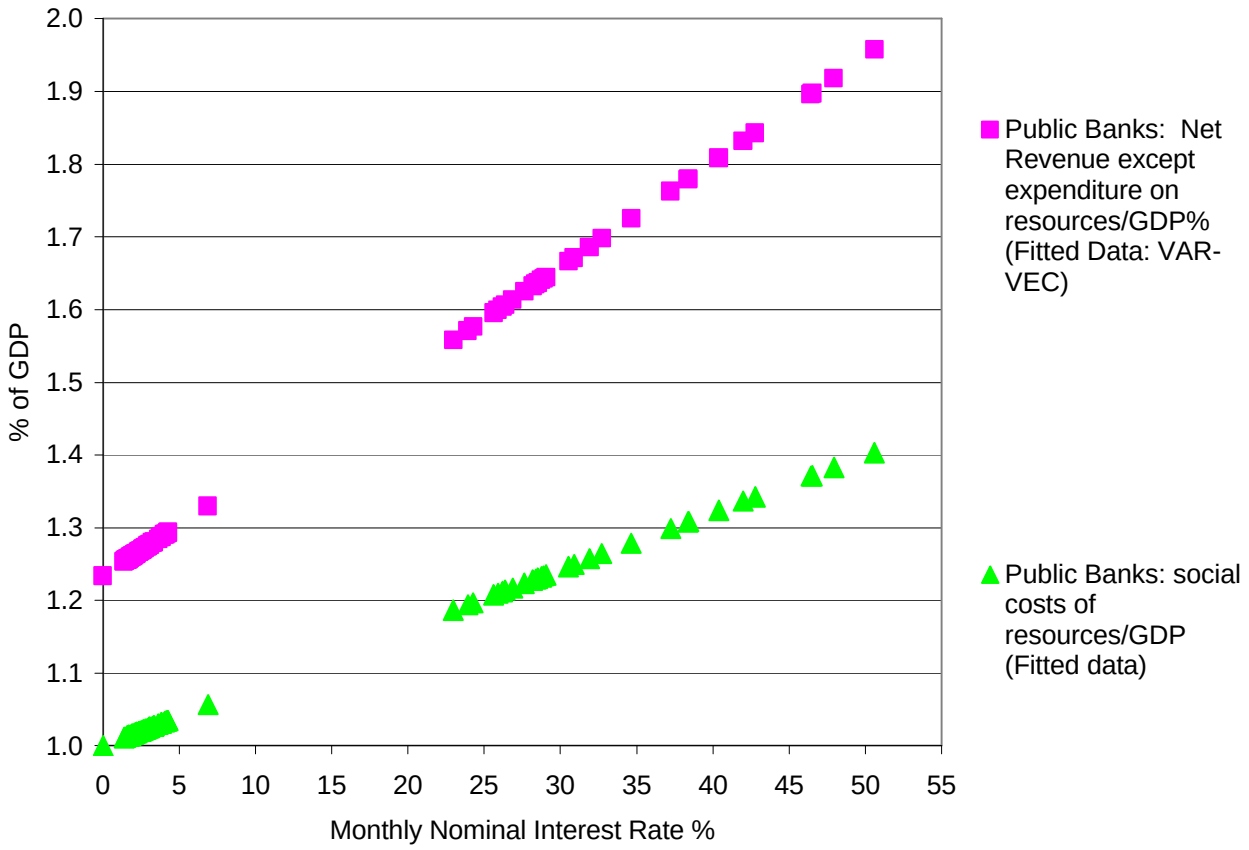

Figure 14. Estimation of Resources Wasted by Official Banks due to Inflation. Brazil: 1992:1-1999:12

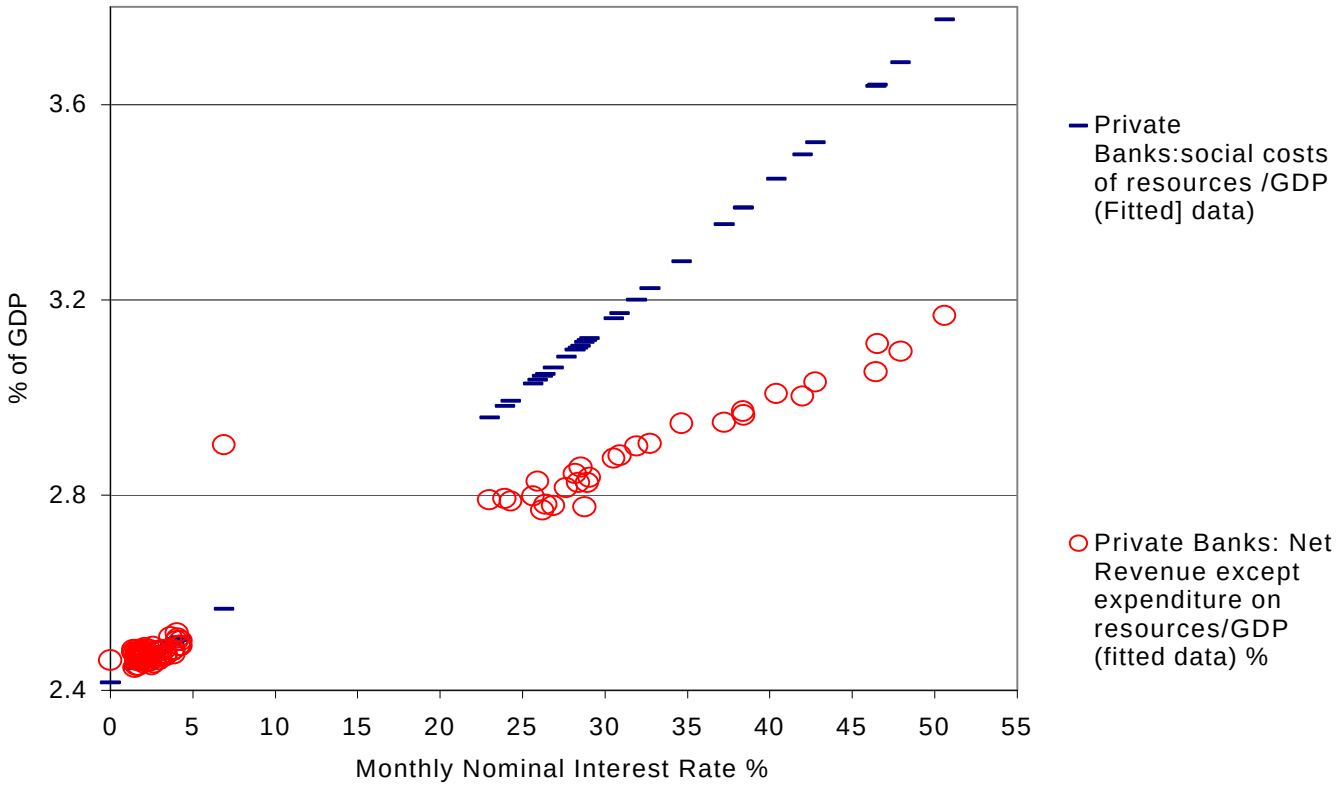

Figure 13. Estimation of Resources Wasted by Private Banks due to Inflation. Brazil: 1992:1-1999:12

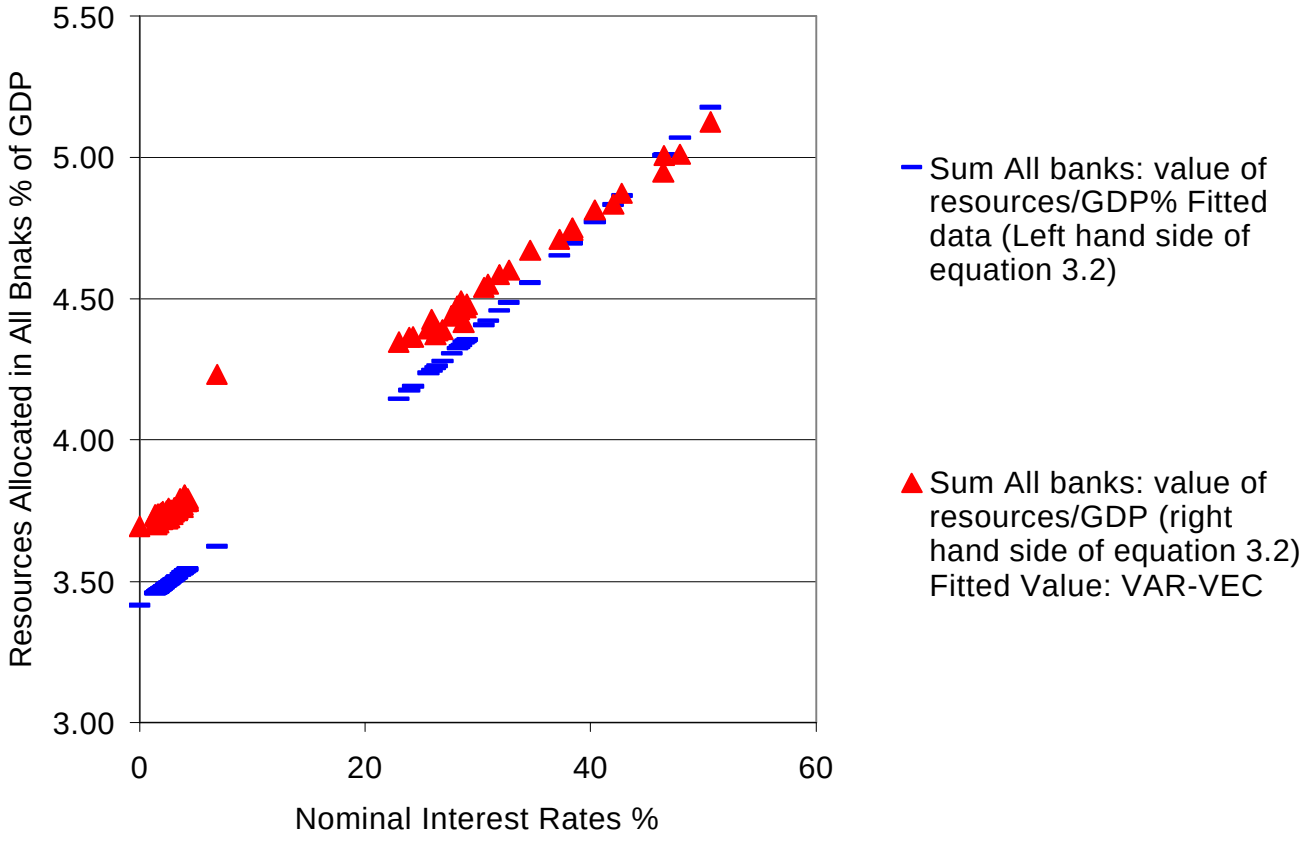

Figure 14. The Additional Inflationary Waste of Resources by the Banking Industry. Brazil: 1992:1 - 1999:12

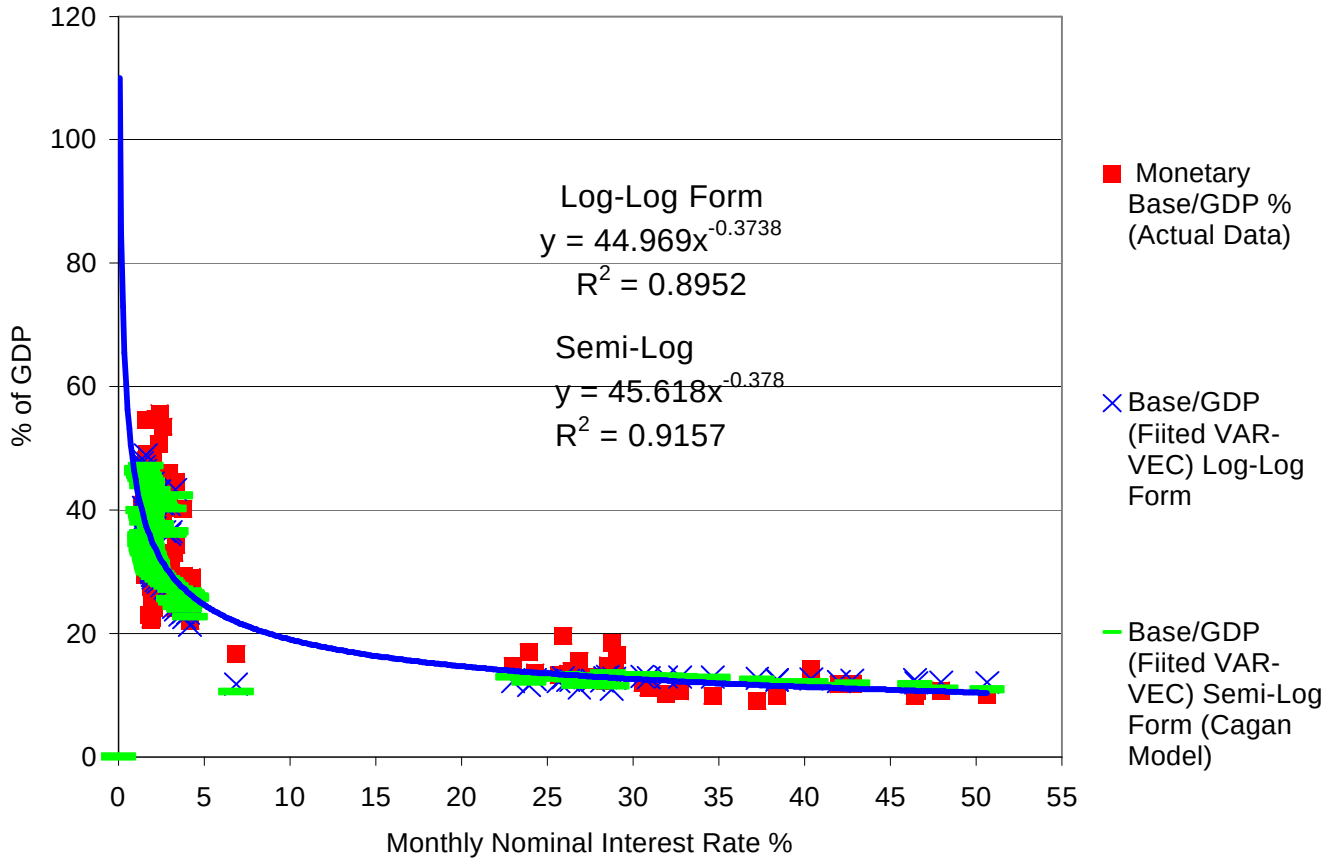

Figure 15. The Demand for Moetary Base: Brazil: 1992:1 1999:12

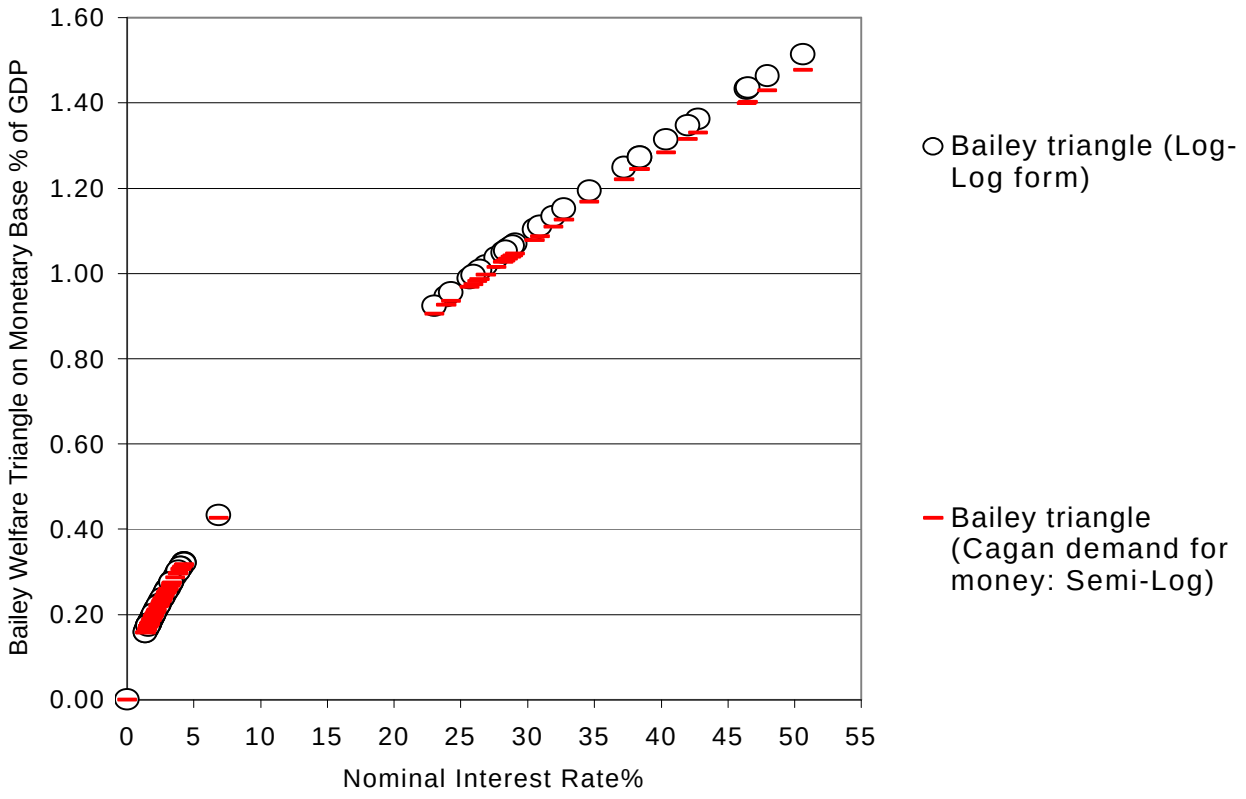

Figure 16. Bailey Welfare Costs of Inflation. Brazil : 1992:1 1999:12

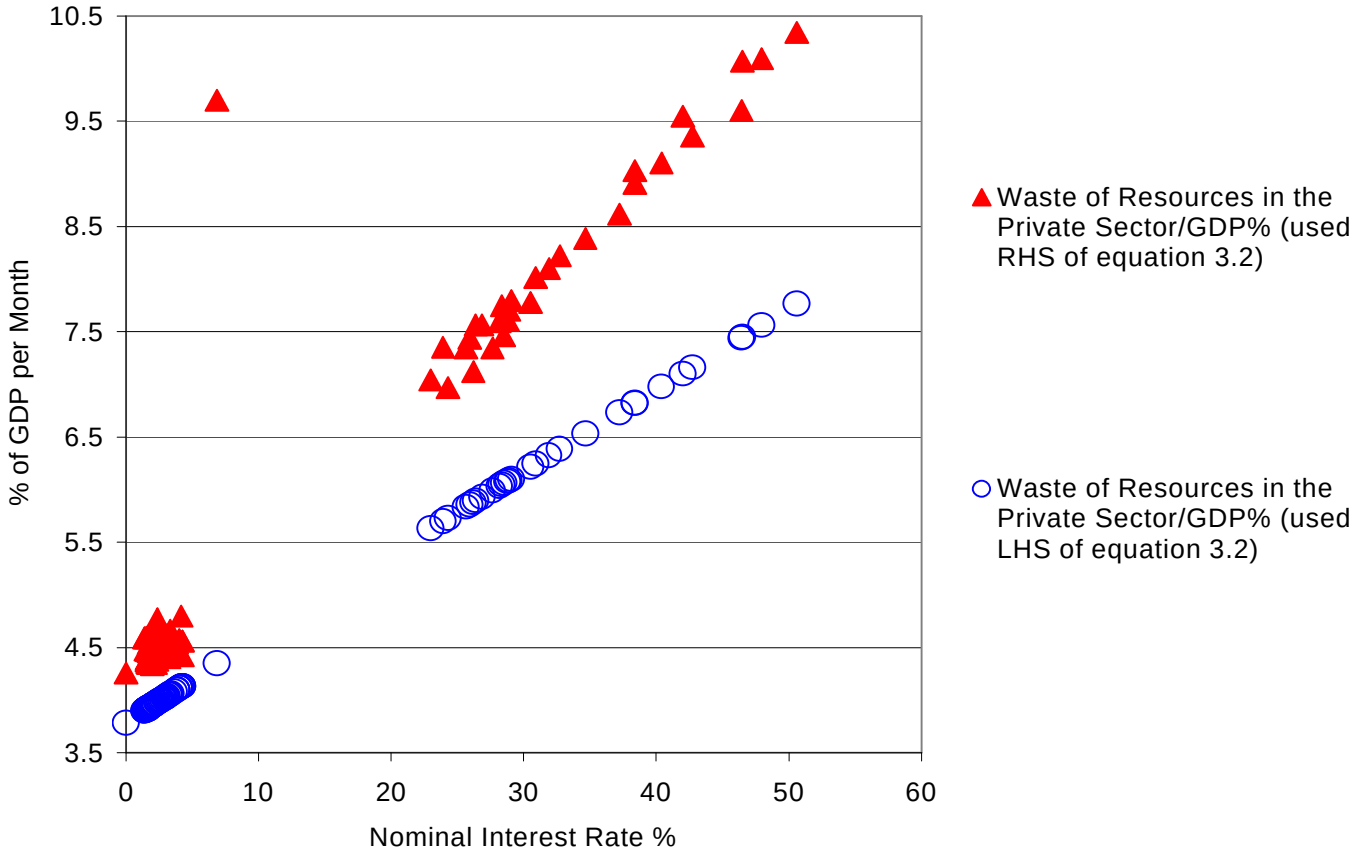

Figure 17. The Inflationary Waste of Resources by Households and Non-Financial Industry. Brazil: 1992:1-1999:12

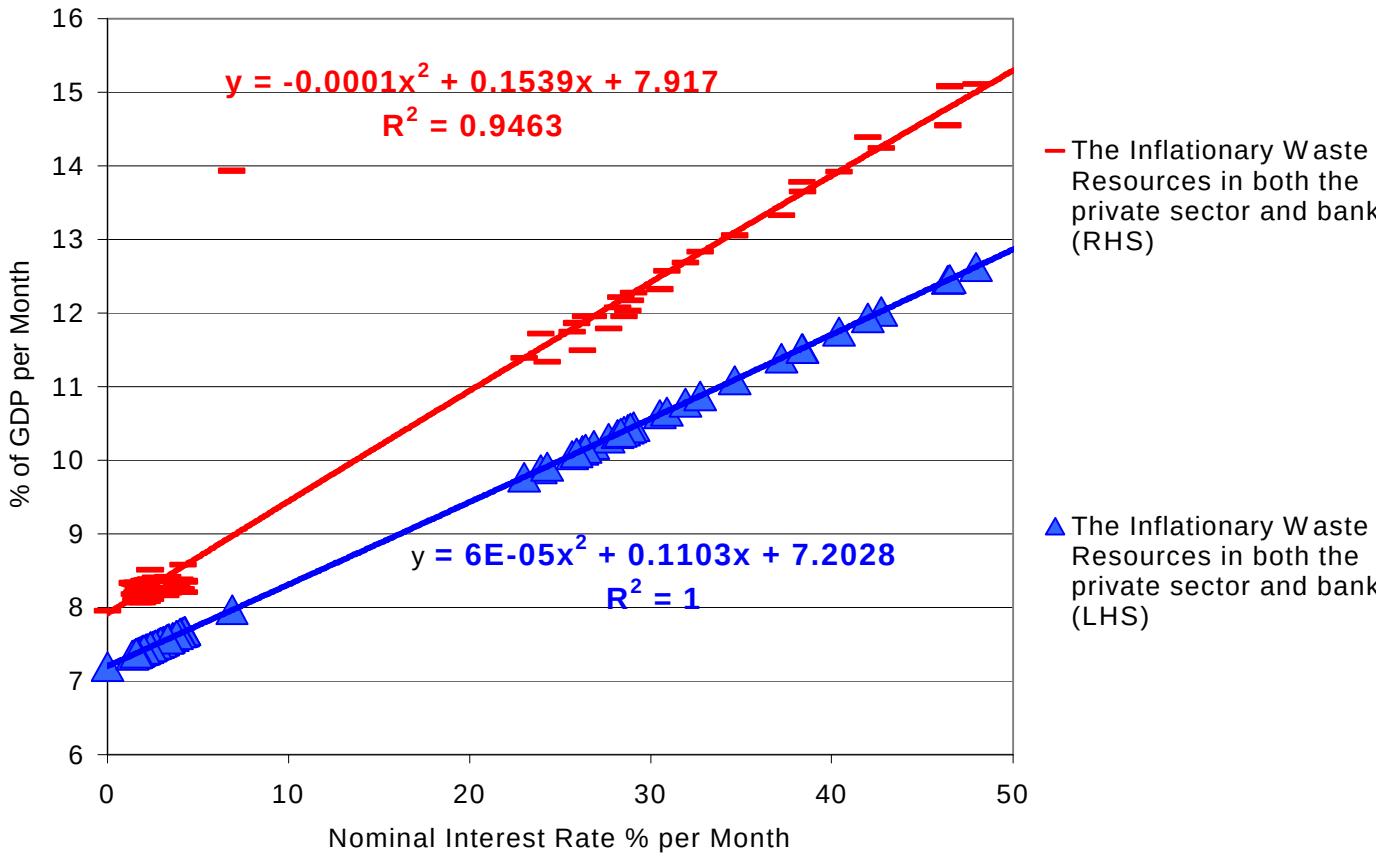

Figure 18. The Additional Inflationary Resources Wasted by the Private Sector (Households and Firms) and Banking Industry. Brazil: 1992:1-1999:12

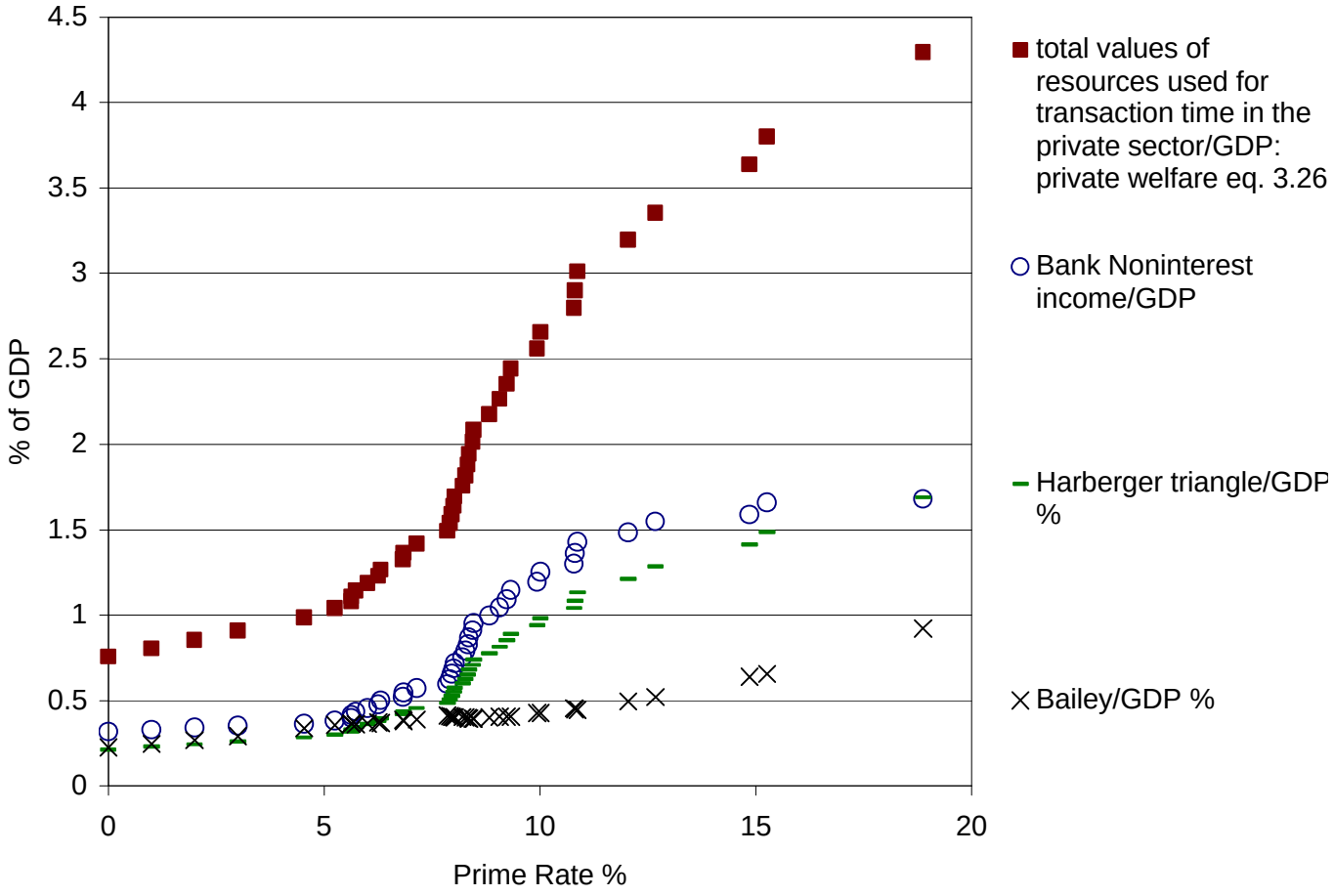

Figure 9B. The Waste in the Private Sector. US

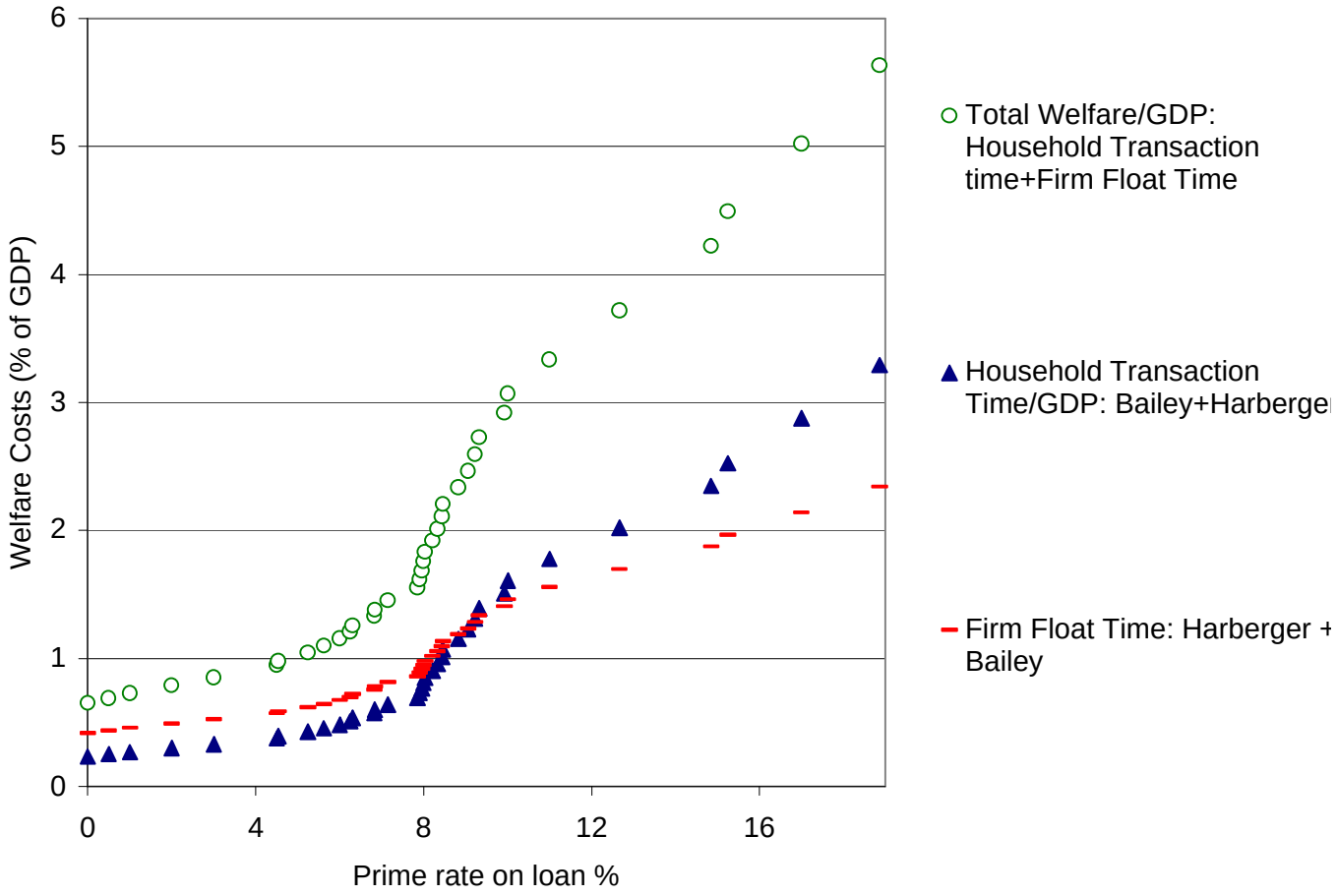

Figure 6. The Fitted (VAR-VEC) Total Welfare Costs of Inflation: Misallocation of Resources in the Manufacturing and Household Sectors. US

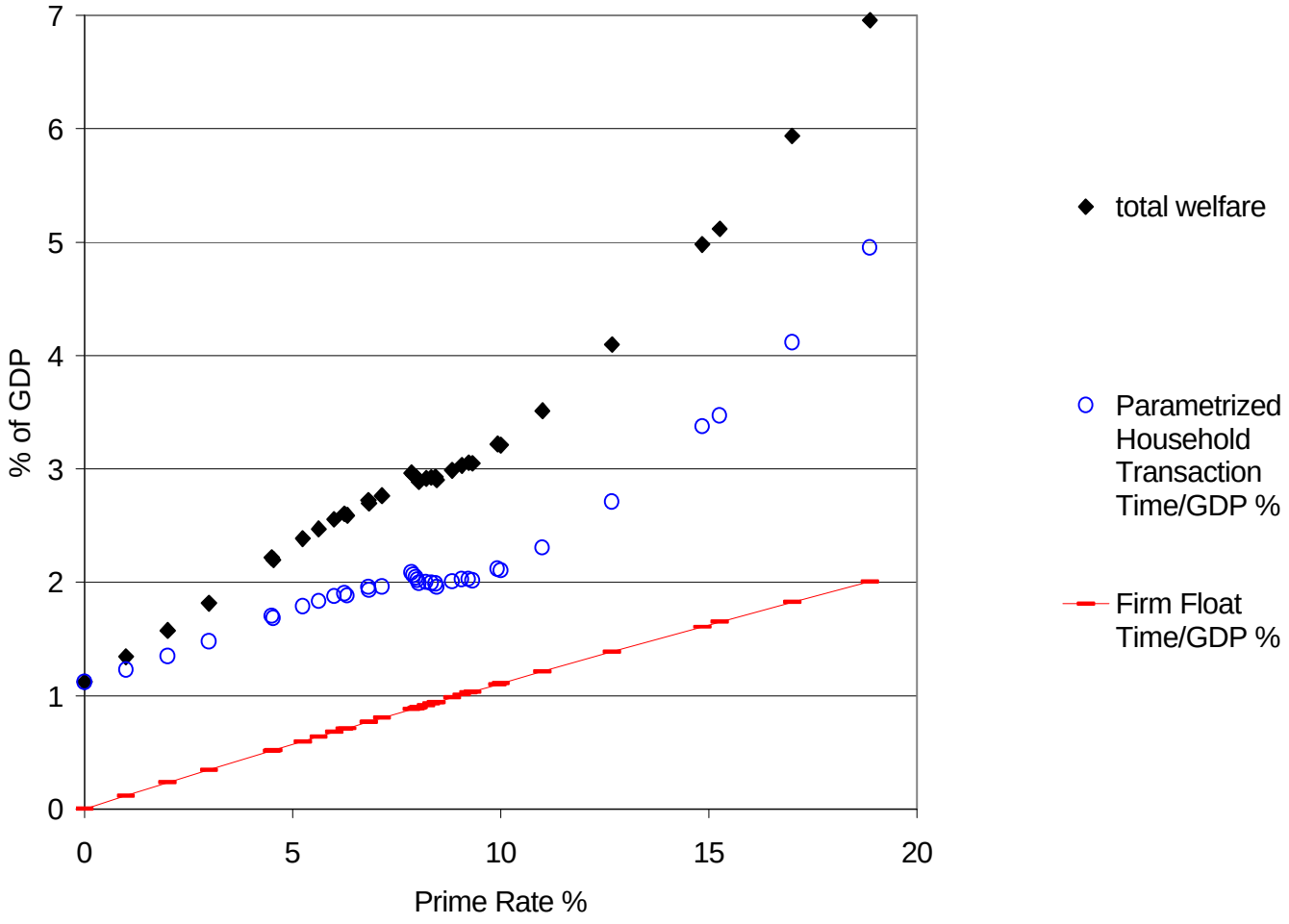

Figure 11. The Parametrized Total Welfare Costs of Inflation. US: 1964-99

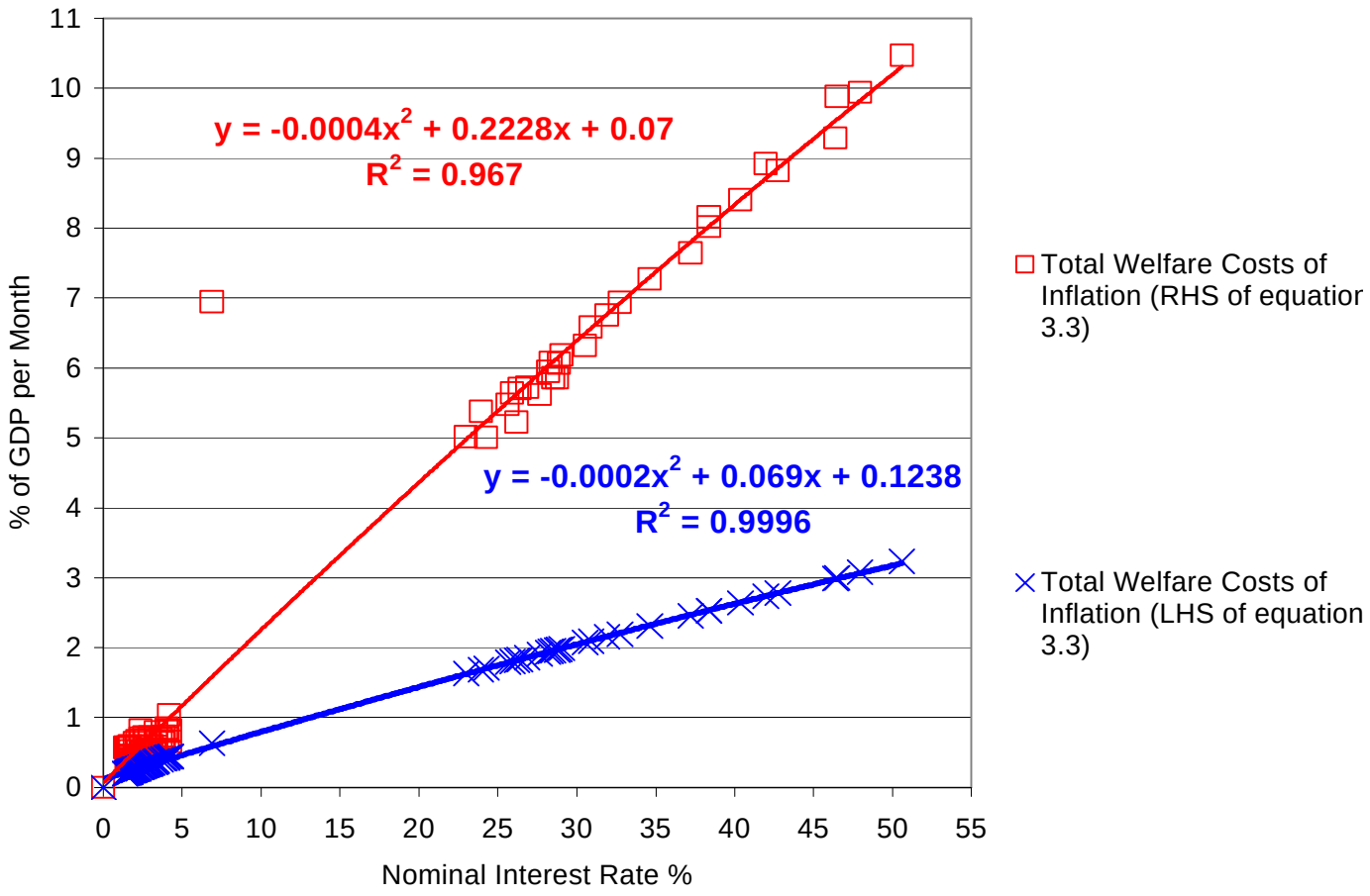

Figure 19. The Total Welfare Costs of Inflation: Misallocation of resources in the Households, Manufacturing and Banking Sectors. Brazil: 1992:1 - 1999:12

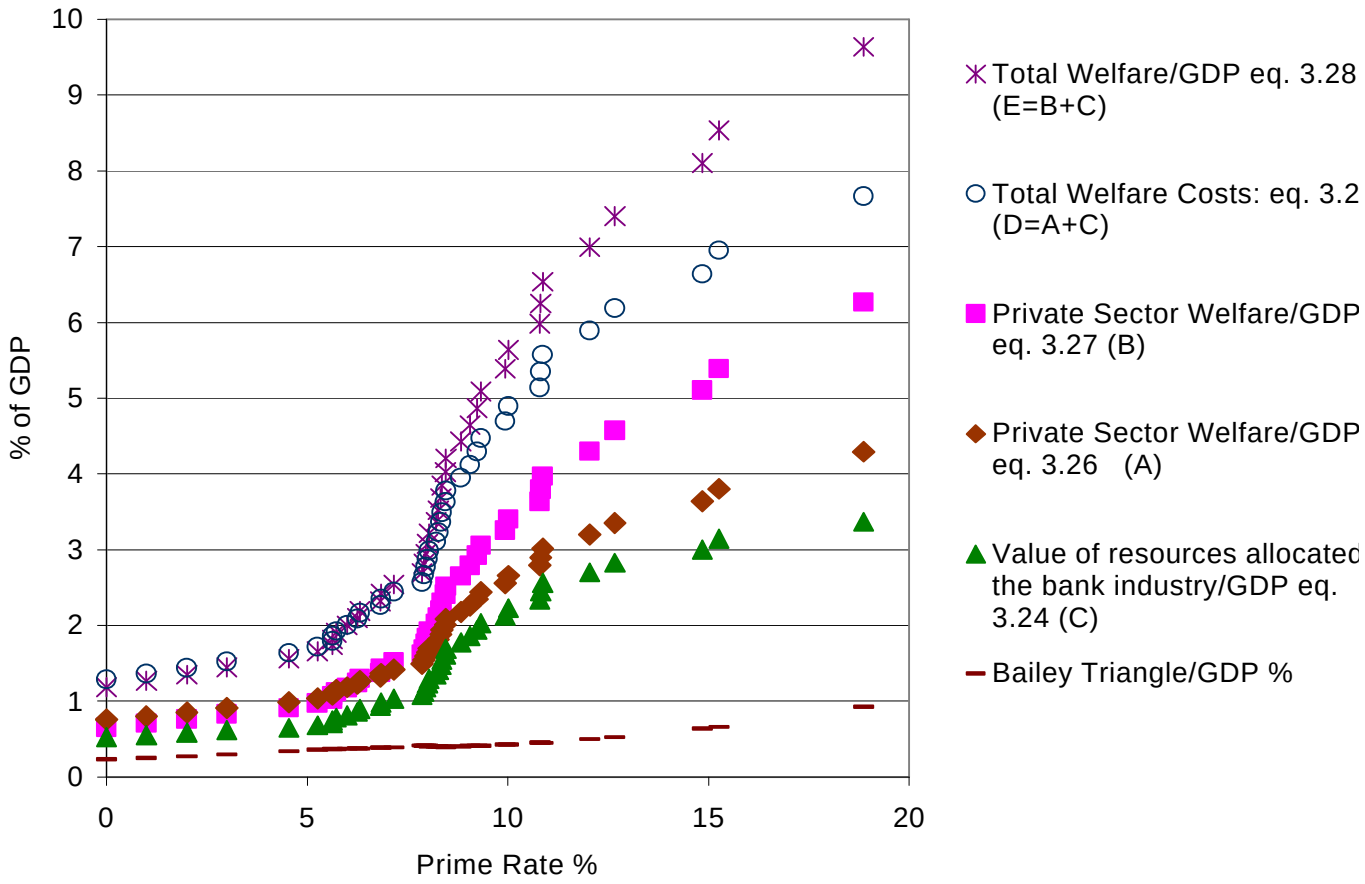

Figure 10. The Total Welfare Costs of Inflation. US: 1965-99

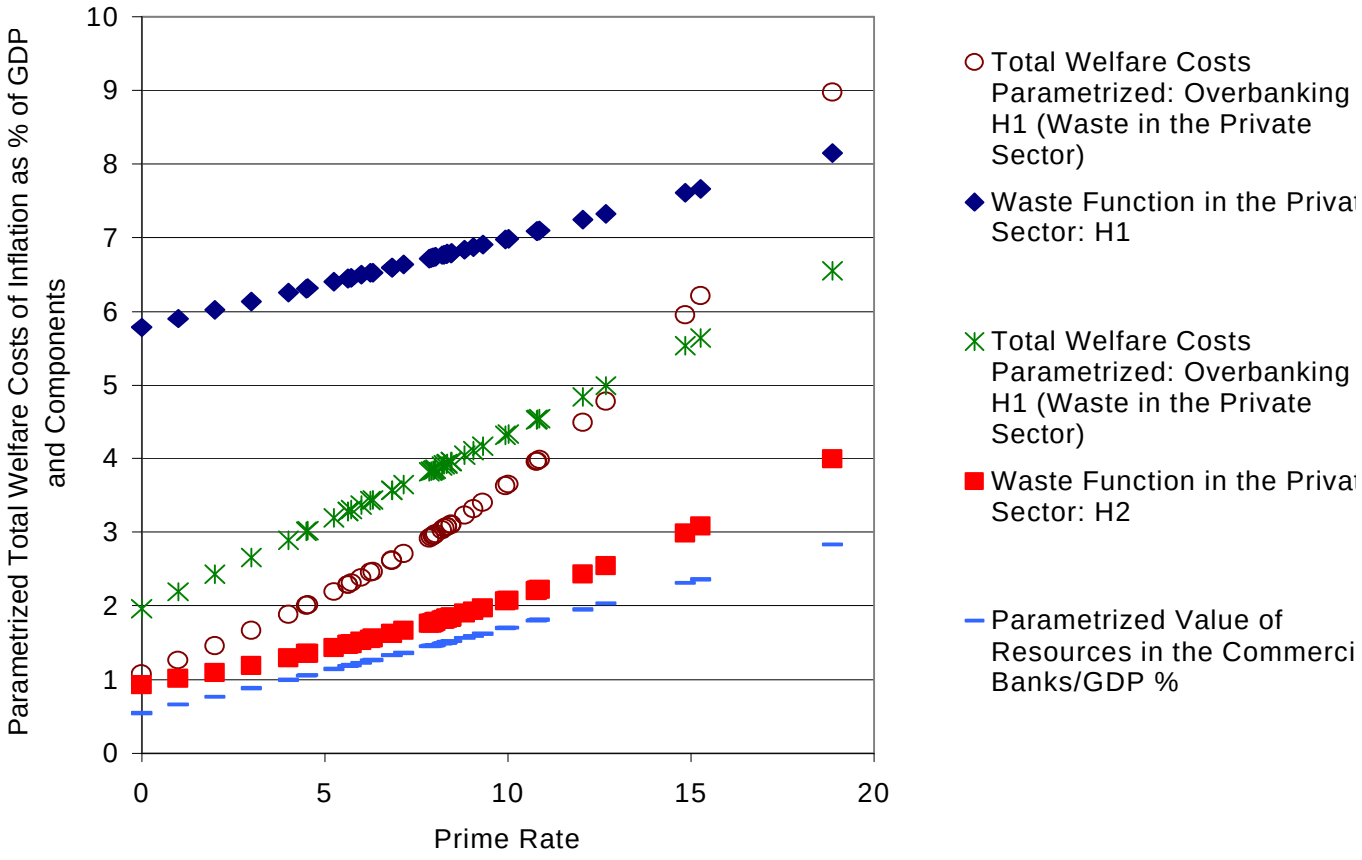

Figure 12. The Parametrized Total Welfare Costs of Inflation and Components. US: 1965-99

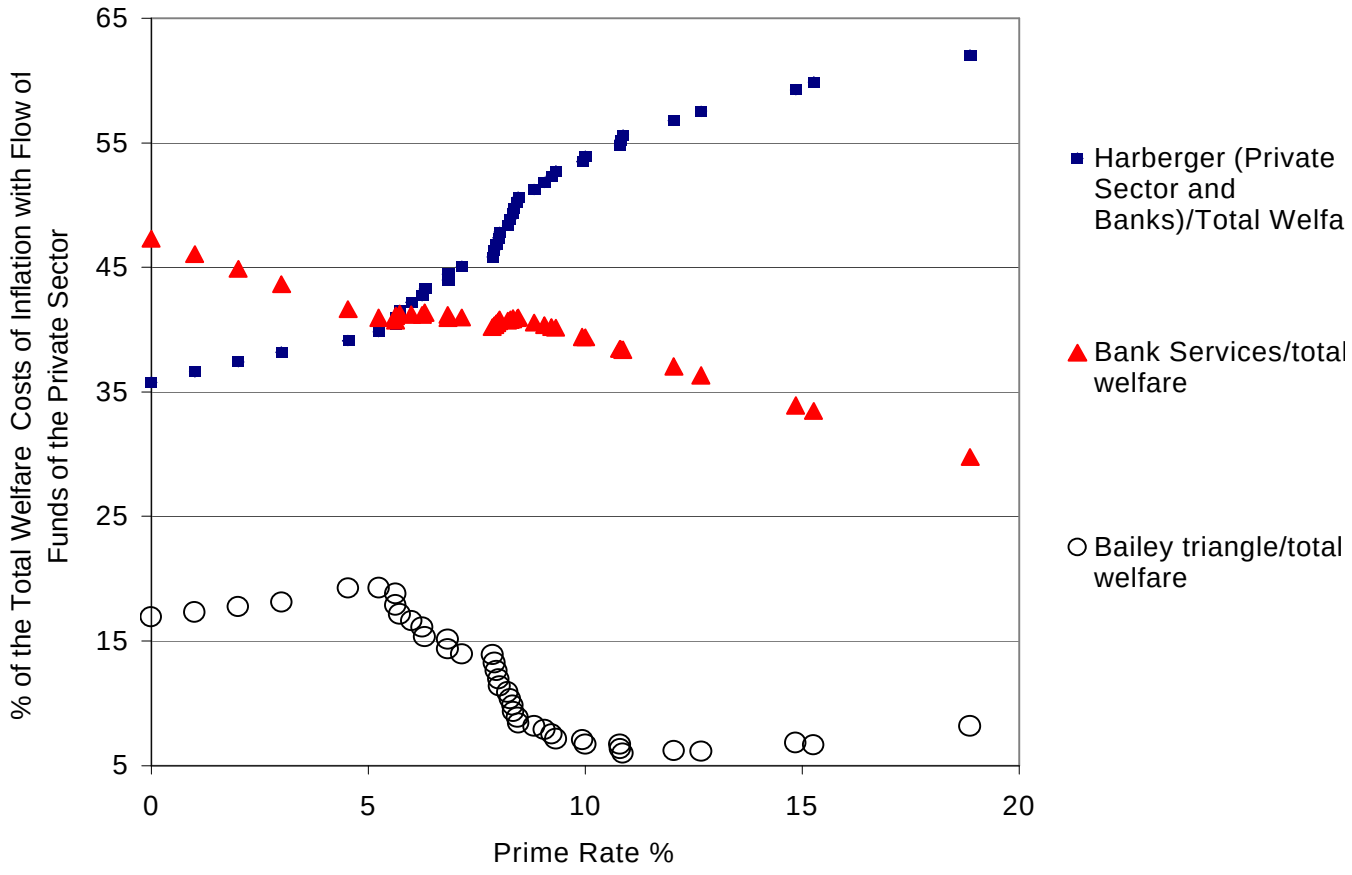

Figure 11. The Distorting Triangles of the Total Welfare. US: 1965-99