

Temporary Exchange Rate-Based Stabilization Programs Under Asset Market Segmentation

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August 2003

Abstract

This paper analyses the welfare consequences of temporary exchange rate-based stabilization programs. Differently than previous papers, however, here we assume that only a fraction of households participates in asset market transactions. With this asset market segmentation assumption, the effects of temporary programs on welfare may change drastically. Households with access to the bonds market are able to protect themselves better from the changes in the inflation rate - although at the cost of a distortion in their consumption path. As a consequence, they may decrease their inflation tax burden - which would increase for the other group of households. By the other side, when these agents that lack the access to the asset markets are credit constrained, they may welcome the program, since the government is temporarily reducing the inflation tax they have to pay. The temporary program could end up benefiting both groups, what could help to understand their popularity.

1 Introduction

Many countries have been adopting exchange rate based stabilization programs in order to fight inflation. There is a vast literature that studies these programs and many of their stylized facts have been registered in papers such as Vegh (1992), and Calvo and Vegh (1999). We observe, once the

plan is implemented, an overvaluation of the local currency and a boom in consumption. These phenomena are accompanied by a large trade deficit. Calvo (1986) was the first to show that these facts could be explained by the lack of credibility of the program. If households believed that the low inflation would be short lived, they would take advantage of the smaller cost of holding money and would consume more during the implementation of the stabilization plan. Once the plan is abandoned, they would go to a lower steady state path of consumption.

Following these papers, exchange rate based temporary stabilization plans would decrease the welfare of the population, since they distort the path of consumption of the households¹. Important to this conclusion is the assumption of unrestricted access to the credit markets by all households. In Calvo's paper (1986), households could trade foreign bonds as long as their intertemporal budget constraint was satisfied. During the stabilization plan, they could borrow from the international asset markets (or use part of their international savings) in order to consume more. Once the plan is abandoned, they start repaying their accumulated debt.

One important fact ignored by these papers is the lack of access to asset markets by a large fraction of Emerging Markets populations². In fact,

¹An exception on this literature is the paper by Alfaro (1999). Alfaro made the conjecture that part of the population is endowed with tradable goods and part with non-tradable goods. With this assumption, she showed that a temporary stabilization plan could make the owners of the nontradable endowment better off. Lahiri (2001), in a paper in which he stress out the role of endogenous labor supply, also argues that it is possible that welfare does not decrease with temporary plans. But he only showed that, if we look only to the stationary equilibrium - ignoring the transition paths -, welfare should decrease.

²Models with asset market segmentation have been widely studied since the works of Grossman and Weiss (1983) and Rotemberg (1984). More recent works in closed economies can be found in Chatterjee and Corbae (1992) and Alvarez, Lucas and Weber (2001). Alvarez and Atkeson (1997) and Alvarez, Atkeson and Kehoe (2002) are works developed in an open economy environment. A common feature of these papers is that all households do have access to the asset markets, but they do so in different moments of time. As a result, these models imply that open market operations reduce the nominal interest rate in the economy, generating what is called the "liquidity effect". In the open economy context, these papers help resolving some puzzles in international finance, such as volatile and persistent real exchange rate movements, and the excess volatility of nominal exchange rates.

Here, differently, we assume that a fraction of the population does not have access to the asset markets at all. As we argue latter, this seems to be a realistic assumption for developing countries. For another reference in an open economy context in which this "stronger" assumption is used, see Lahiri, Singh and Vegh (2002).

a significant fraction of households in these countries does not even have a banking account. Some issues, therefore, may be raised. The first one is that part of the population is not smoothing their consumption path simply because they do not have access to credit markets. If you imagine that a country has good perspectives of growth, or there exists a significant fraction of young workers that expect an increase in their wages along their lives, there could be the case that many households would be willing to borrow in the present moment, but they cannot. So, a temporary stabilization plan could be welcomed by this part of the population. The government would temporarily reduce the inflation tax, leaving more net income for the households. They would take advantage of this lower tax to consume more in the present moment, exactly the moment they would be willing to borrow to do so. There could be the case that inflation in the future would be higher, due to higher debt and lower reserves of the government³. Still, this fraction of the population could be willing to accept this cost.

There is another implication derived from asset market segmentation. Households with access to asset markets hold more cash balances and consume more during the program to take advantage of the temporary low inflation. Of course, due to their budget constraint, they will hold a lower amount of cash balances and will consume less after the program is abandoned. But consumers without access to credit markets cannot behave this way. At least, not as efficiently, since they cannot borrow during the program. Therefore, the first group is more efficient in avoiding the payment of inflation tax than the second one. If the government has a constrained budget constraint and needs a certain amount of seigniorage, this means that the first group will end up paying less inflation tax and the second one will end up paying more.

We insert this asset market segmentation in a small open economy framework. The economy is populated by two types of agents, whose fraction out of the total population is exogenously given. The first type has free access to the bonds markets. These households can buy and sell - or borrow and

³In order to keep the exchange rate at the desired level, governments use interest rates and reserves as important instruments. Increasing interest rates makes local bonds more attractive, contributing to a valuation of the exchange rate. But it also increases the domestic debt. And in a fixed or pegged exchange rate regime, governments must be willing to buy and sell dollars at the targeted rate. Before the failure of the plans, which are usually accompanied by a big devaluation of the exchange rate, we observe a substantial drop in the reserves stock. This drop is the result of the attempt by the monetary authorities to avoid the devaluation

lend - an internationally traded liquid bond that offers a positive rate of return. The second type has this access denied, having as its only asset domestic cash balances. Both groups need these cash balances in order to consume, as we introduce money in the economy through a cash-in-advance constraint. A temporary stabilization program will be modeled as a temporary decrease in the devaluation rate. Therefore, during the program, the domestic nominal interest rate is smaller, which means a smaller opportunity cost of consumption. Bond holders will change bonds by domestic currency and will take advantage of this lower cost of consumption to consume more during the program - and pay less inflation tax. Agents without access to the credit markets are not able to make these operations, but they will smoothly accumulate more cash balances, since the inflation tax is smaller with the program. Therefore, they will also be able to consume more during the plan. If they were credit constrained, they would welcome this possibility of a higher consumption. However, since they are not able to borrow or lend to avoid high inflation periods as households of the other group are, they will end up paying more inflation tax. Ultimately, the size of each effect will be crucial to determine who is benefiting from the program. We argue that, for low - and empirically reasonable - values of the intertemporal elasticity of substitution, both groups could be benefiting from the program.

As we see, taking this market segmentation into account seems to be important in analyzing welfare consequences of temporary programs. And, consequently, in understanding the popularity many of them could achieve.

The rest of the paper is organized as follows. In section 2, we list the main exchange rate based stabilization plans implemented in Latin America in the last 40 years. We also show some stylized facts of these plans. In section 3, we present the model. Initially we show the benchmark case, in which all households have access to the bonds markets. Then, we present the segmented markets model and discuss how it changes the welfare implications of temporary stabilization plans. We also show some simulations and how welfare for the different groups may change with different parametrizations. Section 4 concludes the paper.

2 Some Stylized Facts

Exchange rate based stabilization programs have been vastly documented and studied in the literature. In the attempt to fight inflation, these plans have been implemented by policy makers for decades, with different degrees of success. They have been used to overcome from moderate levels of inflation to hyperinflations. In the present paper, we are more interested in the analysis of chronic inflation cases. Latin America constitutes a very rich source of experiments with this type of plan. During the 60s, for example, Argentina, Brazil and Uruguay implemented plans that relied on fixed exchange rates - or with periodic devaluations in the Brazilian case - and different types of income policies. With the exception of Brazil, the lower inflation was not sustained, mainly due to the lack of fiscal discipline. During the 70s, we observe more orthodox plans, with no prices or wages controls, that relied on a policy of pre-announced devaluation schedules. Argentina, Chile and Uruguay followed these programs. However, even with fiscal adjustments in Chile and Uruguay, these plans ended in an exchange and financial crisis. The real appreciation of the exchange rate, due to the low convergence of inflation to the rate of devaluation, is pointed out as the main source of failure for these plans.

In mid 80s, we see more heterodox plans. Argentina, Brazil and Mexico used wage and price controls to overcome the inertial component of inflation, in the attempt to avoid the overvaluation of the exchange rate. The plans in Argentina and Brazil soon failed with a lack of fiscal control. Finally, during the 90s, we again see Argentina, Brazil and Uruguay implementing more orthodox exchange rate based programs. And, once again, lack of fiscal control and overvaluation of the exchange rate ended up contributing to the collapse of these plans.

Table 1 shows some major stabilization plans in Latin America in the last 40 years. As we can see, these plans have shown to be sustainable only temporarily. The exact reasons for the systematic failure of the programs are still object of discussion. The real appreciation of the exchange rate is pointed out as one of the main reasons. Once the plan is implemented, the exchange rate is kept fixed or devalued at a pre-specified rate, but an inflationary process, though smaller, is still in place in these economies, causing an appreciation of the real exchange rate. This overvaluation of the currency contributes strongly for a deterioration of the trade and current account,

which proves to be unsustainable at the end. The other main explanation for the failure of these programs is the lack of fiscal adjustment. The plans that, after their abandonment, could keep inflation at lower levels than the pre-plan ones, were the ones that had made some fiscal adjustments⁴.

We can ask what are the main stylized facts of these exchange rate based temporary stabilization programs. The first one that stands out is a boom in consumption and real activity. This behavior is even more interesting when we compare it with the contraction in consumption and real activity that usually follows a money based program. This boom in consumption leads to another stylized fact, which is the current account and trade balance deterioration.

Other main facts we should point out are: a) a slow convergence of inflation to the rate of devaluation; b) a sustained real appreciation of the domestic currency; c) an increase in real wages measured in units of the tradable goods; and d) a large fiscal adjustment in temporarily successful programs. For more detailed explanations on the above stylized facts, good references are Vegh (1992), Rebelo and Vegh(1995), and Calvo and Vegh (1999).

Our goal is to build up a model that could not only explain all these facts⁵, but could also be in accordance with the popularity of many of these temporary programs. We will fit the popularity of the programs by adding the realistic assumption that a significant fraction of the population in these countries does not have access to the asset markets. As we have already mentioned in the Introduction, many of their households do not even have access to a banking account. For example, in Brazil, there were 55 millions checking accounts in 2000⁶. Given that many of these accounts belong to firms and many of its citizens have more than two or three accounts, a big fraction of its 170 million inhabitants does not have one. Even if you look at the United States, where asset markets are much bigger, access to these markets are not a reality for many individuals. In 1989, 59 percent of its

⁴In the present paper, we will assume a lack of fiscal adjustment. This assumption is not crucial for the results of the paper, but contributes to make clearer the channels we want to analyze

⁵We are not going to explicitly model all the above stylized facts in our paper. But with small changes in our model, which would not affect its main results, it is possible to incorporate all fo them. For example, Calvo (1986), and Calvo and Vegh (1999) built up very similar models to ours that incorporate a bigger range of stylized facts

⁶Source: Febraban

citizens did not hold any interest bearing assets⁷⁸. And 25 percent did not even have a checking account.

As we have already said, adding a segmented markets framework to traditional models can change dramatically their predictions on the welfare consequences of temporary programs. And it may help to explain one more fact, although we are not going to model it explicitly. During the program, the boom in the consumption of durable goods is much bigger than the overall boom in consumption, as it has already been documented and studied by, for example, De Gregorio, Guidotti and Vegh (1998) and Calvo and Vegh (1999). One possible explanation for this behavior is the fact that part of the population is credit constrained. Durable goods usually are relatively more expensive and many times bought through many installments. Once a temporary stabilization is in motion, it is easy for the population - without access to the asset markets - to save enough cash balances to buy the durable goods. Or, as also explained in Calvo and Vegh (1999), since installments tend to be fixed, during high inflation periods, the first installments are much higher in real terms than the last ones, limiting the credit offered by the stores. Once inflation is low, the real value of these installments are more evenly distributed, what increases the real credit offered to customers.

3 Model

Consider a small open economy perfectly integrated with the rest of the world in the goods market. This economy is populated by a continuous of households of mass 1, which are blessed with perfect foresight. There exists only one non-storable good, whose price in terms of the foreign currency is assumed to be constant. Since there is free movement of the good, purchasing power parity holds. Perfect capital mobility also prevails, but only a fraction λ of the domestic population has access to the asset markets. Interest parity, together with the Fischer equation for the rest of the world, implies that

$$i_t = r + \varepsilon_t \tag{1}$$

⁷Money market accounts, certificate of deposit, bonds, mutual funds and equities.

⁸Source: Mulligan and Sala-i-Martin (2000). Data from the Survey of Consumer Finance.

where i_t is the domestic nominal interest rate, r is the rate of return in the internationally traded bonds, and ε_t is the devaluation rate of the domestic currency.

Let's explain in more details the role of each agent and how this economy works.

3.1 *Households' problem*

There are two types of consumers. The first one, which we will call type B, has free access to the asset markets. In our model, this means that they can borrow or lend internationally traded bonds at the international interest rate r ⁹. The other type, called type NB, does not have access to the bonds market. Their only asset is domestic cash balances.

Each agent j ($j \in B, NB$) maximizes her lifetime utility function given by

$$Max \int_0^{\infty} u(c_t^j) e^{-\beta t} dt \quad (2)$$

where c_t^j is consumption at time t by an individual of type j ; $0 < \beta < 1$ is the constant rate of time preference; and the utility function $u(\cdot)$ is assumed to be increasing, twice continuously differentiable, and strictly concave.

Households are subject to a cash-in-advance (CIA) constraint given by

$$m_t^j \geq \alpha c_t^j \quad (3)$$

where m_t^j is the amount of real cash balances held by individual j at time t . m_t^j is, therefore, given by $m_t^j = \frac{M_t^j}{S_t P^{T*}}$, where M_t^j is the amount of nominal cash balances, S_t is the nominal exchange rate¹⁰, and P^{T*} is the price of one unit of the consumption good measured in units of the international currency. As we said, this price is assumed to be constant.

Type B households

⁹Of course, they can do so as long as they satisfy their intertemporal budget constraint, which will be defined in this section.

¹⁰Measured as the domestic currency value of one dollar, our international currency.

Depending on their types, consumers face different budget constraints. Let's denote the amount of the internationally traded bond held by one type B individual as b_t^B . b_t^B is already measured in terms of the tradable good. τ^B is the amount of government transfers for a type B consumer, again also measured in terms of the consumption good. Finally, y_t^B is the amount of the good the household has as endowment each period. The flow budget constraint of a representative type B consumer can, therefore, be written as

$$\dot{a}_t^B = ra_t^B + y_t^B + \tau_t^B - c_t^B - i_t m_t^B \quad (4)$$

where $a_t^B = m_t^B + b_t^B$.

As long as $i_t = r + \varepsilon_t$ is positive, which we will assume from now on, type B consumer's cash-in-advance constraint will always bind - her opportunity cost of holding cash balances is positive. This means that

$$m_t^B = \alpha c_t^B \quad \forall t \quad (5)$$

Integrating forward the flow budget constraint, applying the transversality condition $\lim_{t \rightarrow \infty} a_t^B e^{-rt} = 0$ and taking into consideration the bindness of the CIA constraint, we get her intertemporal budget constraint

$$\int_0^\infty (1 + \alpha i_t) c_t^B e^{-rt} dt = a_0^B + \int_0^\infty (y_t^B + \tau^B) e^{-rt} dt \quad (6)$$

That is, the present value of the real cost of consumption - after we take into consideration the cost of holding cash balances - is equal to present value of households assets, plus the present value of their endowment and government transfers.

Finally, maximizing the lifetime utility of a type B individual (2), subjected to the above budget constraint, we get her optimality condition

$$u'(c_t^B) = \lambda^B (1 + \alpha i_t) \quad (7)$$

where λ^B is the constant Lagrangian multiplier of the intertemporal budget constraint. We have also assumed in the above derivation that the rate of intertemporal discount β is equal to the international interest rate r . This assumption allows a flat path for consumption when the nominal interest rate is constant. Therefore, for a constant nominal interest rate, during periods of a lower endowment, households borrow in the international markets or use their stock of international bonds to keep their consumption level. When

the endowment is high, they pay back their debts and save for the low endowment periods. This feature is important, as we will see, since temporary stabilization plans distort their consumption path.

Type NB households

Type NB individuals do not have access to the asset markets. This means that they are not allowed to borrow. And, if they want to save, they will have to do so through domestic cash balances. Their flow budget constraint is given by

$$\dot{m}_t^{NB} = y_t^{NB} + \tau_t^{NB} - c_t^{NB} - \varepsilon_t m_t^{NB} \quad (8)$$

where m_t^{NB} and τ_t^{NB} are already measured in terms of the consumption good.

They maximize their lifetime utility (2) subjected to the above flow budget constraint and the cash-in-advance constraint (9). In the present paper, we will attain ourselves to the case in which their CIA constraint binds¹¹.

$$m_t^{NB} = \alpha c_t^{NB} \quad \forall t \quad (9)$$

Given this assumption, their real cash balances path follows the following first order differential equation

$$\dot{m}_t^{NB} = y_t^{NB} + \tau_t^{NB} - \left(\frac{1}{\alpha} + \varepsilon_t\right) m_t^{NB} \quad (10)$$

¹¹We can build the hamiltonian and get the first order conditions for type NB maximization:

$$H = u(c_t) + \lambda_t [y_t + \tau_t - c_t - \varepsilon_t m_t] + \mu_t [m_t - \alpha c_t]$$

FOC:

$$u'(c_t) = \lambda_t + \alpha \mu_t \quad (a)$$

$$m \geq \alpha c_t \quad \mu_t \geq 0 \quad \mu_t [m_t - \alpha c_t] = 0 \quad (b)$$

$$\dot{\lambda}_t = [\beta + \varepsilon_t] \lambda_t - \mu_t \quad (c)$$

$$\dot{m}_t = y_t + \tau_t - c_t - \varepsilon_t m_t \quad (d)$$

Then, with the following assumptions

- 1) y_t is nondecreasing
- 2) τ_t is nondecreasing
- 3) ε_t is constant
- 4) m_0 is $\leq m_S$, where $m_S = \frac{y_t + \tau_t}{1/\alpha + \varepsilon_t}$

it is easy to verify that $m_t = \alpha c_t$ is part of the solution of the system given by the FOCs.

This equation shows clearly how dependent is consumption on the path of the endowment and on the monetary policy of the government. For example, for a given rate of devaluation, consumers cannot borrow to consume more today even when they expect a big increase in their disposable income.

3.2 *Government*

The government issues domestic money, holds international reserves - foreign bonds - and makes lump sum transfers to the households. Its flow budget constraint can be written as

$$\dot{h}_t = rh_t + \dot{m}_t + \varepsilon_t m_t - \tau \quad (11)$$

where h are the international reserves, m represents the real cash balances in the economy and τ are the transfers. The variables are denoted in per capita terms. This equation basically says that the rate of accumulation of reserves by the government is given by the difference between its revenues - interest rate on current reserves plus revenues from money creation - and its costs - the transfers to households. Taking into account the government transversality condition $\lim_{t \rightarrow \infty} h_t e^{-rt} = 0$, equation (11) gives us the government intertemporal budget constraint

$$\int_0^{\infty} \tau e^{-rt} dt = h_0 - m_0 + \int_0^{\infty} (i_t m_t) e^{-rt} dt \quad (12)$$

which says that the present value of government expenditures must be equal to the present value of government net assets and seigniorage.

We will assume that the government has a fiscal constraint, that is, τ will be fixed along the model¹². Hence, the monetary authority has to adjust its

¹²In the complete markets case, the results are the same if the government transfers could be adjusted to the seigniorage revenue it collects. During the temporary stabilization plan, the transfers would be reduced, to be increased back again once the plan is abandoned. See, for example, Calvo (1986). Here, we don't want the transfers to the type NB households to be reduced, since we want exactly to explore the fact that they are credit constrained and are able to consume more during the stabilization plan. And, at the same time, we don't want any wealth transfers from one group to the other due to changes in the government transfers. Therefore, although a fixed τ is not strictly necessary for our main results, it will make them clearer.

policy to satisfy the government budget constraint. If it temporarily reduces seigniorage due to the stabilization plan, a higher inflation tax will have to be collected in the future, as it is clear from the government intertemporal budget constraint.

3.3 *Equilibrium conditions*

First of all, since τ is denoted in per capita terms, we have that

$$\tau = \lambda\tau^B + (1 - \lambda)\tau^{NB} \quad (13)$$

And from the money market equilibrium condition

$$m = \lambda m^B + (1 - \lambda)m^{NB} \quad (14)$$

The current account for the economy follows from the households and government flow constraints - equations (4), (10) and (11) -, taking into account (13) and the equilibrium in the money market (14)

$$\dot{h}_t + \dot{b}_t = r(h_t + b_t) + y_t - \lambda c_t^B - (1 - \lambda)c_t^{NB} \quad (15)$$

Here, b_t is the per capita amount of international bonds held by households. Therefore, $b_t = \lambda b_t^B$. For simplicity, we have assumed that $y_t^B = y_t^{NB} = y_t$. As expected, asset accumulation will be given by the interest in the current assets, plus the endowment of the economy, minus the total consumption of households. Integrating forward and using the transversality conditions for the government and type B households, we get the economy intertemporal budget constraint

$$\lambda \int_0^\infty c_t^B e^{-rt} dt + (1 - \lambda) \int_0^\infty c_t^{NB} e^{-rt} dt = h_0 + b_0 + \int_0^\infty y_t e^{-rt} dt \quad (16)$$

The above equation simply states that the present value of total consumption in the economy is equal to the present value of its endowment and total assets.

3.4 *Solution of the Model*

Initially, we solve the model for the case in which all households have access to the bonds market. In this case, we are going to get the known result that a temporary exchange rate based stabilization reduces welfare, since it distorts the consumption path of the households. With this result in mind, we then analyze the segmented markets case. Once part of the population does not have access to the asset markets, a temporary stabilization plan may affect positively the welfare of different segments of society. This is possible due to two channels. The first one is based on the fact that part of the population may be credit constraint. In this case, a temporary program would reduce the inflation tax initially, allowing the credit constrained households to consume more. The second channel is an inflation tax redistribution one. Households that do not have access to the bonds market cannot increase their cash holdings instantaneously once the plan is implemented, in order to take full advantage of the temporary lower effective price of consumption. Nor they can change cash holdings by bonds once the plan is abandoned. But the households with access to the asset markets can make these instantaneous changes of cash balances; and they do so in order to take advantage of the initial lower effective price of consumption, that is, the initial lower inflation, and to avoid the higher inflation later. Therefore, they end up paying less inflation tax, which means that the first group will pay more¹³. With the program, the government is allowing a transfer of resources from type NB individuals to type B ones. The next sections will explain in a detailed way these observations.

3.4.1 *Complete markets case*

In this section, we assume that all households have access to the bonds market. That is, $\lambda = 1$ and we only have type B consumers. One assumption that we will keep along the paper is a "strong" fiscal constraint for the

¹³Remember that we have assumed that the government expenditures, its transfers, are fixed. This means that, by the government intertemporal budget constraint, it needs to collect the same amount of the present value of the inflation tax.

government. That is, it cannot decrease its expenditures, the transfers to households, even temporarily¹⁴.

Let's suppose that the initial devaluation rate - which is equivalent to the inflation rate - is set at a constant value that satisfies the government intertemporal budget constraint (12). If, together with this budget constraint, we take into account the households' first order condition (7) and the economy's resource constraint (16), this constant rate of devaluation must be equal to

$$\varepsilon_0 = \frac{G - h_0}{\alpha(h_0 + b_0 + Y)} \quad (17)$$

where $G = \int_0^\infty \tau e^{-rt} dt$ and $Y = \int_0^\infty y_t e^{-rt} dt$

From the interest parity condition (1), we get that the nominal interest rate is constant. Therefore, consumption is also constant, as can be verified by the households' first order condition (7). Then, using the economy's resource constraint, we get that

$$c^B = r(h_0 + b_0 + Y) \quad (18)$$

Equation (17) is reflecting the fact that the present value of inflation tax must be equal to the present value of the government net deficit - its expenditures minus its reserves¹⁵. And equation (18) is just telling us that the constant consumption must be equal to each period return on the present value of this economy wealth.

Now, suppose the government implements an exchange rate based stabilization program. In our model, this program will consist of a lower devaluation rate $\varepsilon_1 (< \varepsilon_0)$. Given the fiscal constraint of the government, it is easy to see that this policy is not sustainable¹⁶. The stabilization plan will be

¹⁴This assumption is not important for this section, where all agents have access to the bonds market. But it will play an important role when we study the segmented markets case.

¹⁵Equation (17), together with equation (18) and the cash in advance constraint (5), can be written as $\varepsilon_0 \frac{m_0}{r} = G - h_0$

¹⁶Suppose it were. From the first order condition of consumer maximization (7), consumption should be constant. Then, from the resource constraint of the economy (16), this consumption should not change from its initial level c_0^B . Consequently, seigniorage would fall - $i_t m_t$ would fall. This means that it is impossible to satisfy the government intertemporal budget constraint (12).

temporary. We make the natural assumption that the initial rate of devaluation is set such that seigniorage falls during the program¹⁷. More specifically, we assume that $i_t m_t$ falls while the program is in place. Since the government has to satisfy its budget constraint (12), $i_t m_t$ will eventually have to increase to higher values than the pre-plan ones. More intuitively, during this stabilization period, the monetary authority has to use its reserves - or borrow from households - to keep the desired lower devaluation rate¹⁸. In order to finance its expenditures, the government prints more money than it is consistent with the lower devaluation rate. Households get rid off these excess cash balances by buying reserves from the government at the target exchange rate. Since these reserves were a source of revenue, through their

¹⁷If the government is at the right side of the Lafer curve, we should expect this decrease in seigniorage with a lower inflation (devaluation) rate - and an increase once the devaluation rate is set at a higher level. That is what we observe when countries decrease their inflation rates. Given the parameters of the model, the chosen devaluation rate ε should be such that

$$\frac{\partial i m}{\partial i} > 0 \quad (\text{a})$$

In the present paper, we work with the following constant elasticity of substitution form for the utility function

$$u(c_t) = \frac{c_t^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}$$

Since we want a strictly concave utility function, we set the intertemporal elasticity of substitution $\sigma > 0$. For $\sigma < 1$, (a) is always satisfied. And for $\sigma > 1$, we can use the first order condition and the CIA to show that we have to guarantee that $\varepsilon < \frac{1}{\alpha(\sigma-1)} - r$.

¹⁸We can rewrite the government flow constraint as

$$\dot{h}_t = r h_t - r m_t + \dot{m}_t + i_t m_t - \tau$$

In the initial steady-state equilibrium, with the constant devaluation rate ε_0 , we have that

$$\dot{h} = 0 = r h_0 - r m_0 + i_0 m_0 - \tau$$

During the implementation of the exchange rate based stabilization program, the rate of devaluation ε_1 is set at a constant lower level. By the first order condition, this means that $m_t = m_1$ is also constant during the plan. At $t = 0$, when the program starts, households change bonds by cash balances:

$$\Delta h_{0+} = \Delta m_{0+}$$

We can, therefore, rewrite the government flow constraint as

$$\dot{h}_0 = r(h_0 + \Delta h_{0+}) - r(m_0 + \Delta m_{0+}) + 0 + i_1 m_1 - \tau$$

which implies

$$\dot{h}_0 = r h_0 - r m_0 + i_1 m_1 - \tau$$

Since we have assumed that $i_1 m_1 < i_0 m_0$, $\dot{h}_0 < 0$. Together with the fact that the flow constraint of the government is an unstable differential equation, we have that the government continuously loses reserves during the implementation of the program.

interest payments, the government will need even more seigniorage after the plan is abandoned. Therefore, ε will have to increase and so will the inflation tax¹⁹. We also assume that this new devaluation rate will be constant from the day of the abandonment on²⁰.

In our perfect foresight environment, households know exactly the moment T in which the government will abandon the stabilization program. From the consumers' first order condition (7) and the assumption of a strictly concave utility function, we see that consumption will be higher while the plan is in place, compared with its level after T . By the economy resource constraint (16), this means that consumption will increase once the plan is implemented, and it will drop below its original level c_0^B after its abandonment, as it is shown in figure 1²¹.

In summary, when the government implements its temporary stabilization plan, setting a lower rate of exchange rate devaluation, households take advantage of the lower nominal interest rate - lower opportunity cost of consumption - and consume more. Once the higher ε is set to satisfy the government budget constraint, they start consuming less. This temporary stabilization decreases households welfare, since it distorts their consumption path. To show this more clearly, let's define

$$V \equiv \int_0^\infty u(c_t)e^{-\beta t} dt \quad \text{and} \quad \Delta \equiv \frac{i_T}{i_{T-}}$$

We can write

$$\frac{\partial V}{\partial \Delta} = u'(c_1) \frac{\partial c_1}{\partial \Delta} \frac{(1-e^{-\beta T})}{r} + u'(c_2) \frac{\partial c_2}{\partial \Delta} \frac{e^{-\beta T}}{r}$$

Using the economy resource constraint (16), we get that

¹⁹We could associate the eventual abandonment of the stabilization program with a BOP crisis. The assumptions in the present model are similar to the ones in Krugman (1979) and Flood and Garber (1984) models of BOP crises due to fiscal constraints. We could, therefore, think that, once the reserves reach a certain threshold, a crisis takes place with the government abandoning its stabilization plan and letting the exchange rate float

²⁰As we prove at the end of this section, a constant devaluation rate generates a smooth path for consumption, being, therefore, the optimal one.

²¹By the economy resource constraint

$$\int_0^\infty c_t^B e^{-rt} dt = W$$

$$\text{where } W \equiv h_0 + b_0 + \int_0^\infty y_t e^{-rt} dt$$

With the first order condition, we got that

$$c_0^B = rW$$

We can, therefore, write that

$$c_1^B(1 - e^{-rT}) + c_2^B(e^{-rT}) = c_0^B$$

Since by the first order condition we have that $c_1^B > c_2^B$, the above equation gives us $c_2^B < c_0^B < c_1^B$

$$\frac{\partial c_1}{\partial \Delta}(1 - e^{-rT}) = -\frac{\partial c_2}{\partial \Delta}e^{-rT}$$

Plugging this expression in the previous one, we get that

$$\frac{\partial V}{\partial \Delta} = [u'(c_2) - u'(c_1)] \left[\frac{\partial c_2}{\partial \Delta} \frac{e^{-rT}}{r} \right]$$

Using the first order condition (7) and the economy resource constraint (16), we have already shown that $\frac{\partial c_1}{\partial \Delta} > 0$ and $\frac{\partial c_2}{\partial \Delta} < 0$. And since $u'(c_2) > u'(c_1)$, we have that $\frac{\partial V}{\partial \Delta} < 0$, that is, welfare decreases with the temporary stabilization program.

3.4.2 *Segmented markets*

In this section, we analyze the economy when it is populated by both types of agents, that is, $\lambda < 1$. Note that type NB consumption path will depend not only on the government monetary policy, but also on the exogenous endowment path. This is very intuitive, since this group is not able to borrow during moments in which its endowment is low.

In order to get more intuition, we will first start with a qualitative analysis for the constant endowment path case²². Assuming we are along a stationary equilibrium, type NB flow constraint (10) gives us

$$c_0^{NB} = \frac{y + \tau^{NB}}{1 + \alpha\varepsilon_0} \quad (19)$$

and the first order condition for type B individuals (7), together with their intertemporal budget constraint (6), gives us

$$c_0^B = \frac{rb_0^B + y + \tau^B}{1 + \alpha\varepsilon_0} \quad (20)$$

Note that, as we have already mentioned, we assume that the government transfers to households are fixed. From the above steady-state relations, the economy resource constraint (16) and equation (13), we get the devaluation

²²During this analysis, we will assume that type NB cash-in-advance constraint binds. For a constant endowment path, we will need a sufficiently big elasticity of intertemporal substitution. Otherwise, households could eventually want to save through their cash balances during the temporary stabilization program. And the quantitative solution of the model would get much more complex. That's why we will go only through a qualitative analysis for this case. Latter, when we assume a future increase in the endowment, we will derive quantitative results.

rate ε_0 . Since we have a constant consumption path for both groups, this rate of devaluation is the same as before, given by (17).

Again, the government is not able to reduce the rate of devaluation permanently. We have already showed that, if the government is at the right side of the Lafer curve, seigniorage coming from the type B group will decrease while the plan is being implemented. Now, using the flow constraint for type NB individuals (10), we also get that $\frac{\partial im^{NB}}{\partial i} > 0, \forall i$ ²³. Inflation tax paid by these consumers also decrease when the nominal interest rate is set at a lower value. Hence, since by the government intertemporal budget constraint (12), the present value of the inflation tax cannot be reduced, a permanent decrease in the devaluation rate is not possible. If the government implements an exchange rate-based stabilization program without fiscal reforms, this program is bounded to fail. Eventually the government will have to increase the devaluation rate. And in order to satisfy its budget constraint, the rate of devaluation will have to be set at an even higher level than the original one²⁴.

The temporary stabilization program has an intertemporal effect on the consumption profile of both groups. For the individuals that are able to trade bonds, this effect is the same as before. They borrow to consume more while the stabilization plan is being implemented; and they consume less once the plan is abandoned, as it is clear from their first order condition.

For the individuals without access to the asset markets, we also observe an increase in consumption while the program is in effect. But this increase is smooth. Since they cannot borrow, households slowly accumulate real cash balances in order to consume more. This is possible because the inflation tax is smaller during this period²⁵. Once the plan is abandoned, these house-

²³From type NB flow constraint, in the steady state with a constant rate of devaluation ε we have that

$$m_{SS} = \frac{y+\tau}{1/\alpha+\varepsilon}$$

which we can rewrite as

$$im = y + \tau + (r - 1/\alpha) \frac{y+\tau}{1/\alpha+\varepsilon}$$

Since, for any reasonable values of the parameters, $1/\alpha > r$, whenever the government decreases ε , im_{SS} also decreases. Besides, since $\dot{m} > 0$ during the plan, $i_1 m_t < i_1 m_{SS}^1$ ($< i_0 m_{SS}^0$) for $0 \leq t < T$. We have that $\frac{\partial im}{\partial i} > 0$.

²⁴As we explained before, while the plan is being implemented, the government is using its reserves to keep the lower devaluation rate. Since the government loses the interest proceeds from the lost reserves, it will have to count on a higher seigniorage once the plan is abandoned.

²⁵We can use type NB households' flow constraint to show that $\frac{\partial \dot{m}}{\partial \varepsilon} < 0$.

holds will decrease their consumption, but again in a smooth path. Since the inflation tax is higher after T, the higher level of cash balances is not sustainable. Households will consume each time less, going in the direction of their new steady-state level of consumption. Because the rate of devaluation will have to be set to a higher level than the original one, consumption at the new steady-state will be lower than the pre-plan one. Figure 2 follows from type NB flow constraint, assuming households' consumption was at its steady-state path before the implementation of the program - and, as we have said, that the CIA constraint always binds. It shows the path of consumption for these individuals under a temporary stabilization program and a constant path for their endowment. Time 0 refers to the date of the implementation of the plan, and time T to the date of its abandonment.

However, linked to this intertemporal effect on the consumption path, there is also an "inflation tax redistribution effect". As we have explained earlier, households with access to the credit markets can immediately acquire more real cash balances once the plan is set in motion, taking advantage of the lower opportunity cost of consumption. And they can also get rid off the excess cash balances immediately after the program is abandoned, changing them by bonds. This way, they decrease the amount of inflation tax they would have to pay during the high seigniorage period. This behavior is not allowed to type NB households. Once the plan is implemented, they can only slowly accumulate cash balances. This means that they cannot take "full advantage" of the lower inflation rate. And once the plan is abandoned, their higher initial level of cash balances will be heavily taxed. Since we assume fixed transfers to households by the government, the present value of government revenues cannot change, as already explained earlier. This means that the present value of the inflation tax cannot change. Therefore, type NB individuals will end up paying more inflation tax, while type B will end up paying less.

In order to analyze the welfare consequences of these type of programs over the economy, we have to take into account these two effects. For a constant path of the endowment, and a constant rate of devaluation, nobody is credit constrained with the steady state amount of cash holdings²⁶. Therefore, a temporary stabilization plan distorts the consumption path of both groups. That is, the consumption intertemporal effect is welfare reducing for

²⁶Even if type NB consumers could borrow, they would not do so, as it is very clear from the behavior of type B consumers.

both types of agents. On the other side, there is a transfer of some inflation tax from type B individuals to the type NB ones. So, both effects reduce the welfare of type NB individuals. But type B individuals benefit from the lower inflation tax they have to pay. If the inflation tax paid by them is reduced significantly, they could end up benefiting from the temporary stabilization plan. Next section, we will run some simulations that show how these inflation tax redistributions can be quite significant.

One main characteristic of developing countries, however, is the lack of access to the credit markets by a big fraction of their populations. And for many of the households that have access to some sort of credit, this credit is very expensive, since they cannot offer reliable guarantees that the debt will be paid. Another indirect evidence of the unfulfilled demand for credit is the boom in sales of durable goods during stabilization plans. We should expect a boom in consumption during a temporary stabilization plan, as we explained along the paper. But the boom in the consumption of durable goods is much stronger. And these are the types of goods that are usually bought through credit²⁷.

Once part of the population is in fact credit constrained, the impact on welfare of a temporary stabilization program may be quite different. The temporary program modify the path of the inflation tax. During the plan, seigniorage is reduced. After its abandonment, this tax must be increased to finance the government transfers. But this policy could benefit the credit constrained households. They are less taxed exactly in a moment they are credit constrained. Later, they start paying a higher tax. Therefore, it is as if the government is lending to these households. Once the plan is abandoned, they start paying back their "loans" through a higher inflation tax.

In order to model these credit constraints, we assume that households expect an increase on income in the future. Households without access to the asset markets are not able to smooth their consumption. They cannot borrow against their future higher income. And making things as simple as possible, we assume that households will have their endowment increased discretely T periods from the day of the implementation of the plan²⁸. The

²⁷Lack of credit is not the only possible explanation for the boom in the consumption of durable goods. For an explanation based on credit constraints, see Calvo and Vegh (1999). For an alternative explanation, see De Gregorio, Guidotti and Vegh (1998).

²⁸We could also assume a smooth growing path for households endowment and we would get essentially the same results. The solution of the households' problem, however, would get much more complicated for lower values of σ , since consumers could eventually decide

endowment will jump from a lower level y_L to a higher level y^H .

Let's suppose that households are initially following a constant consumption path where ε_0 is the constant rate of devaluation that satisfies the government budget constraint. Type NB flow constraint (10) gives us

$$c_t^{NB} = c_0^{NB} = \frac{y_L + \tau^{NB}}{1 + \alpha\varepsilon_0} \quad \text{for } t < T \quad (21)$$

$$c_t^{NB} = \frac{y^H + \tau^{NB}}{1 + \alpha\varepsilon_0} + \left(c_T^{NB} - \frac{y^H + \tau^{NB}}{1 + \alpha\varepsilon_0} \right) e^{-(\frac{1}{\alpha} + \varepsilon_0)(t-T)} \quad \text{for } T \leq t \quad (22a)$$

and the first order condition for type B individuals (7), together with their intertemporal budget constraint (6), gives us

$$c_t^B = c_0^B = \frac{r(b_0^B + \int_0^\infty y_t e^{-rt} dt) + \tau^B}{1 + \alpha\varepsilon_0} \quad \forall t \quad (23)$$

Note that type B individuals are able to smooth their consumption, which is based not only on the value of their present endowment y_L , but on the present value of their whole stream of endowments $\int_0^\infty y_t e^{-rt} dt$. On the other side, type NB consumption is initially limited by the value of their present endowment y_L . Only after T , when they start receiving a bigger endowment, is that their consumption will increase.

The temporary stabilization program changes these paths drastically. As we have already explained, our temporary plan with fiscal constraints will be characterized by a temporary lower devaluation rate ε_1 , followed by a higher devaluation rate ε_2 ($\varepsilon_2 > \varepsilon_0$). Again, following the first order condition of type B individuals (7), together with their intertemporal budget constraint (6), we get that

$$c_t^B = c_1^B \equiv \frac{rW_0^B}{(1 + \alpha i_1)(1 - e^{-rT}) + (1 + \alpha i_1)^\sigma (1 + \alpha i_2)^{1-\sigma} e^{-rT}} \quad \text{for } 0 \leq t < T \quad (24)$$

$$c_t^B = c_2^B \equiv \frac{rW_0^B}{(1 + \alpha i_1)^{1-\sigma} (1 + \alpha i_2)^\sigma (1 - e^{-rT}) + (1 + \alpha i_2) e^{-rT}} \quad \text{for } T \leq t \quad (25)$$

to use their cash balances to save. That is, the CIA constraint would not always bind.

where $W_0^B = m_0^B + b_0^B + \int_0^\infty y_t e^{-rt} dt + \tau^B / r$.

And from type NB flow budget constraint (10), we get that

$$c_t^{NB} = \frac{y_L + \tau^{NB}}{1 + \alpha \varepsilon_1} + \left(c_0^{NB} - \frac{y_L + \tau^{NB}}{1 + \alpha \varepsilon_1} \right) e^{-(\frac{1}{\alpha} + \varepsilon_1)t} \quad \text{for } 0 \leq t < T \quad (26)$$

$$c_t^{NB} = \frac{y^H + \tau^{NB}}{1 + \alpha \varepsilon_2} + \left(c_T^{NB} - \frac{y^H + \tau^{NB}}{1 + \alpha \varepsilon_2} \right) e^{-(\frac{1}{\alpha} + \varepsilon_2)(t-T)} \quad \text{for } T \leq t \quad (27)$$

Type B consumption is not smooth anymore. And since $i_1 < i_2$, $c_1^B > c_2^B$. Compared to its original path, the above equations for type NB individuals show a bigger consumption while the plan is in effect, at the expense of a relatively lower consumption after this is abandoned. The simple reason is that households are paying less inflation tax during the plan, and more once this is abandoned. Figure 3 illustrates the effect that a temporary stabilization program of duration T may have on the consumption path of both types of households.

Note that, as in the benchmark case, the intertemporal effect on consumption is harmful for the households with access to the bonds markets, since they are not smoothing their consumption anymore. But it is doing exactly the opposite with the credit constrained households. It is fixing, at least partially, the previous distortion on the consumption path of these individuals. Distortion that came from the lack of access to the credit markets. With the plan, type NB households are able to have a smoother consumption path.

We still have to take into consideration the redistribution of the inflation tax. Again, since the type NB households cannot increase their real cash balances instantaneously, while type B can, they cannot take "full advantage" of the lower inflation rate. Type NB consumers will end up paying more inflation tax; and type B consumers will end up paying less. The size of each effect is crucial to determine who is benefiting from the program. Since the computation of the size of these effects is somehow complex, next section we present some numerical analyses. With them, we try to capture not only the welfare effect on each group, but also the size of the inflation tax redistribution.

3.4.3 SIMULATIONS

Up to now, we have discussed how a temporary stabilization program can affect the consumption paths and, consequently, the welfare of households. However, due to the complexity of the calculations, it is not very easy to identify who is benefiting from the program. In this section, we run some simulations aimed to capture the possible size of the programs' effects on the inflation tax redistribution and on welfare.

First of all, we have shown that, when $\varepsilon_1 < \varepsilon_0$ - that is, when the government implements a temporary program with a lower devaluation rate -, $\varepsilon_2 > \varepsilon_0$ - the rate of devaluation after the abandonment of the plan is higher than the original one. But we have not actually computed these values. In order to find ε_0 , we can use the consumption paths of households (21), (22a) and (23), the CIA constraints (5) and (9), the equilibrium in the money market (14) and the government intertemporal budget constraint (12) - or the economy resource constraint (16)

$$\begin{aligned}
0 = & h_0 + b_0 + \frac{y_L(1 - e^{-rT}) + y^H e^{-rT}}{r} - \lambda \left[\frac{rb_0^B + \tau^B + y_L(1 - e^{-rT}) + y^H e^{-rT}}{r(1 + \alpha\varepsilon_0)} \right] - \\
& -(1 - \lambda) \left[\frac{(y_L + \tau^{NB})(1 - e^{-rT})}{r(1 + \alpha\varepsilon_0)} + \frac{(y^H + \tau^{NB})e^{-rT}}{r(1 + \alpha\varepsilon_0)} \right] - \\
& -(1 - \lambda) \left[\left(c_T^{NB} - \frac{y^H + \tau^{NB}}{1 + \alpha\varepsilon_0} \right) \frac{e^{-rT}}{1/\alpha + \varepsilon_0 + r} \right]
\end{aligned}$$

where c_T^{NB} is defined as in equation (26) for $t = T$.

Using this equation, we can get how ε_0 changes with the various parameters of the model. For example, as expected, the higher the government transfers τ , the higher the devaluation rate ε_0 , since the government needs more seigniorage to finance its higher expenditures. And the higher the proportion of households with access to the bonds market, the higher ε_0 . This last relation comes from the fact that, contrary to bondholders, type NB households still have to accumulate cash balances in order to consume more when their endowment increases at T. Also, since type B households have a constant consumption path and type NB are always credit constrained, ε_0 is independent of the elasticity of intertemporal substitution.

Suppose now that the government implements a temporary stabilization program of duration T. Using households initial consumption given by (23)

and (21), their CIA constraints (5) and (9), their consumption paths given by equations (24), (25), (26) and (27), the equilibrium in the money market (14) and the economy resource constraint (16) - or the government intertemporal budget constraint (12) -, we get the following equation relating ε_2 to ε_1

$$\begin{aligned}
0 = & h_0 + b_0 + \frac{y_L(1 - e^{-rT})}{r} + \frac{y^H e^{-rT}}{r} - \lambda \left[c_1^B \frac{(1 - e^{-rT})}{r} + c_2^B \frac{e^{-rT}}{r} \right] - \\
& -(1 - \lambda) \left[\frac{y_L(1 - e^{-rT})}{r(1 + \alpha\varepsilon_1)} + \left(m_0^{NB} - \frac{y_L}{1/\alpha + \varepsilon_1} \right) \frac{(1 - e^{-(1/\alpha + \varepsilon_1 + r)T})}{(1 + \alpha\varepsilon_1 + \alpha r)} \right] - \\
& -(1 - \lambda) \left[\frac{y^H e^{-rT}}{r(1 + \alpha\varepsilon_2)} + \left(\alpha c_T^{NB} - \frac{y^H}{1/\alpha + \varepsilon_2} \right) \frac{e^{-rT}}{(1 + \alpha\varepsilon_2 + \alpha r)} \right]
\end{aligned}$$

where c_1^B is defined as in equation (24), c_2^B is defined as in equation (25) and c_T^{NB} is defined as in equation (26) for $t = T$.

Again, we can get the variation of ε_2 with many parameters of the model. For example, the lower ε_1 and the bigger the duration of the plan, the higher ε_2 .

Having found ε_0 and ε_2 , we have the exact paths of households' consumption and cash holdings. We can, therefore, compute the inflation tax paid by each agent type and get the size of the inflation tax redistribution that takes place with the temporary program. Alternatively, we can compute the present value of consumption for each type under both scenarios - with and without the plan - and get this magnitude of the inflation tax redistribution. Also, we can compute how households welfare changes with the program.

Before we proceed to the simulations, let's make a quick comment on some estimations for elasticities of substitution in developing countries. We find in the literature researches that, depending on the framework employed, have found estimations that are somehow different. For example, the earlier works of Giovannini (1985) and Rossi (1988), using an one-good, non-monetary framework, could not find estimations that were statistically different than zero. Than, with the introduction of more than one type of good, more significant results were found. For example, Ostry and Reinhart (1992) have found estimations for Latin America that stay around 0.40, with standard errors around 0.12. Models that incorporated monetary considerations have found even higher estimations. The work of Eckstein and Leiderman (1991) for Israel, for example, has estimations that range from 0.15 to 1.32²⁹. Given

²⁹For other estimations and a quick review of the relevant empirical evidence on this

these empirical evidences, we will attain our attention in the simulations to parameters smaller than 3.

Table 2 shows some estimations for the changes in the present value of consumption and welfare for each agent type. We also present the devaluation rates required to satisfy the government intertemporal budget constraint. Our stabilization plan will be characterized by a devaluation rate ε_1 equal to zero. The estimations for the changes in the present value of consumption are already shown in percentage points. And the estimations for the welfare gains or losses are presented as the equivalent percentage increase in consumption households should be given each period in the case of no plan to be as well off as they would be with the plan. That is, how much more consumption should be given to households to have them voting against the plan.

The values for many of the parameters we use are presented below the table. The first line of each section on the table shows the different values for the elasticity of substitution used. The second and third lines present the percentage changes in the present value of consumption for type NB and type B households, respectively. The fourth and fifth lines present the consumption equivalent changes in welfare for type NB and type B households, respectively. Finally, the sixth line presents the different rates of devaluation ε_2 needed to satisfy the government budget constraint. With the table, we also present some graphs with the results for σ ranging from 0.05 to 3.

Some results deserve some comments. We can start with the fact that, for small values of σ , the credit constrained type NB households benefit greatly from the plan. That's what we should expect. A low σ means that households are unwilling to exchange intertemporally their consumption. They have a strong preference for smooth paths. That is, type NB households are "more" credit constrained. They would accept to change much of their future increase in net earnings by a small increase in their present consumption. Note that the benefit from the plan is quite similar independently of the proportion of each household type in the economy. Another aspect that contributes for this big benefit is the fact that type B households are not willing to exchange much consumption intertemporally either. This means that they will not take a big advantage of the temporary lower inflation, not consuming much more during the plan. Consequently, they will not be able to pay much less inflation tax and the inflation tax redistribution will be small, as can also be verified in the tables through the changes in the present value of consumption. As a more parameter, see Reinhart and Vegh (1995).

general result, as σ gets bigger, the credit constrained type NB households benefit less from the plan. Not only they are less credit constrained, but the amount of inflation tax they pay will be higher, as it can be seen from the higher ε_2 or the lower present value of consumption. Type B exchanges more and more consumption intertemporally as σ increases, avoiding the inflation tax..

Other point that should be noted is the decrease in the program's welfare benefits for both groups as the proportion of type B households increases. The bigger the proportion of these type of households, the bigger is the amount of consumption that is being exchanged intertemporally. That is, the bigger is the total consumption during the plan and, consequently, the smaller is the consumption afterwards. This means that the devaluation rate after the plan will be higher - due to a smaller amount of "taxable" cash balances - and type NB households will be more strongly taxed. But because the number of type B households is also bigger, each of these consumers will benefit less from these inflation tax transfers. In other words, the losses of per capita present value of consumption will be higher for type NB individuals - they will pay more inflation tax -, and the per capita gains will be smaller for type B individuals - their inflation tax reduction will be smaller.

Having in mind the explanations in the above two paragraphs, note that the way type B welfare changes with σ depends on the fraction of these households in the population. For a small fraction, welfare gains increase with σ . However, for a big fraction, we observe the opposite relation: welfare gains decrease with σ - or welfare losses increase. With a higher elasticity, these households are more willing to substitute intertemporally their consumption. This means that they will try to take a bigger advantage of the lower inflation period, consuming much more while the plan is in effect. When type B group is small, the government does not lose too much inflation tax revenues from these intertemporal change on consumption. Therefore, it does not need to increase ε_2 too much, even when σ is high. But this means that type B households have relatively less incentive to change consumption intertemporally, what contributes to a smaller distortion in their consumption path. When the fraction of type B households is big, the seigniorage losses by the government from this group are also big, which prompts a higher ε_2 . This higher ε_2 , by its way, increases even more the distortion in type B consumption path. And the benefit from a lower payment of inflation tax is not enough to compensate type B individuals for the intertemporal distortion on their consumption path.

4 CONCLUSION

Exchange Rate-based stabilization programs have been widely implemented by countries with a history of chronic inflation. And, in most cases, their success have been only temporary. In spite of their "temporariness", most of them have received a high popular support. But this is in odds with the traditional literature, which points out that temporary plans are welfare decreasing, since they distort the consumption path of households.

In the present paper, we showed that this might not be the case once markets are segmented. We built up a simple framework in which part of the population has access to the bonds markets, and part does not. The households with complete access to the asset markets are able to perfectly smooth their consumption path, while the other group is not. This means that some households may be credit constrained. They would like to consume more today - giving up some future consumption -, but they are unable to do so. A temporary program means that the inflation tax will be smaller while the plan is being carried out. This increases the disposable income of households, allowing them to consume more. In the future, when the government is obliged to abandon the plan - for fiscal reasons, for example -, inflation would come back again. So, it is as if the government is lending to these households, and it will collect the debt in the future in the form of a higher inflation tax.

The welfare consequences of this intertemporal effect on consumption are the opposite for the unconstrained households. Having access to the bonds market, they are able to borrow to consume more during the low inflation period - a period in which the cash balances necessary to buy the consumption goods are less taxed by inflation. And when inflation is high again, they may pay back their debts and consume less. So, they have their consumption path distorted. The effect of this distortion on welfare is negative.

However, even these households may gain from the program. Exactly because they consume more during the program - when the tax on cash balances is lower -, and less once this is abandoned, they are able to pay less inflation tax. Assuming the government fiscal expenditures are fixed, the government will end up collecting more inflation tax from the group without access to the bonds markets, since this group is not as efficiently able to avoid the inflation tax as the first one. We would observe an inflation tax redistribution.

We have, therefore, two effects that work in opposite directions depending on the households accessibility to the bonds markets. We showed in the model that, if households without access to the asset markets are credit constrained, both groups may benefit from the temporary stabilization plan. These effects may help understand why these programs are implemented so often, even when their chances of success are not too high.

We built up a very simple framework to analyze welfare consequences of temporary programs under market segmentation. Richer environments could be studied. For example, we assumed a fixed output, not affected at all by the temporary plan or inflation. Also, the credit constraint restriction could be endogenized, as well as the market segmentation itself.

5 REFERENCES

Alfaro, L. (1999), "Why Governments Implement Temporary Stabilization Programs," *Journal of Applied Economics* 2, 211-245.

Alvarez, F. and A. Atkeson (1997), "Money and Exchange Rates in the Grossman-Weiss-Rotemberg Model," *Journal of Monetary Economics* 40, 619-640.

Alvarez, F., A. Atkeson and P. Kehoe (2002), "Money, Interest Rates, and Exchange Rates with Endogenously Segmented Asset Markets," *Journal of Political Economy* 110, 73-112.

Alvarez, F., R. Lucas Jr. and W. Weber (2001), "Interest Rates and Inflation," *American Economic Review* 91, 219-225.

Calvo, G. A. (1986), "Temporary Stabilization: Predetermined Exchange Rates," *Journal of Political Economy* 94, 1319-1329.

Calvo, G. A. (1987), "On the Cost of Temporary Policy," *Journal of Development Economics* 27, 245-261.

Calvo, G. and C. A. Vegh (1999), "Inflation Stabilization and BOP Crises in Developing Countries," in J.B. Taylor and M. Woodford, eds., *Handbook of Macroeconomics*, Chapter 24, Volume 1, (Elsevier Science B.V.) 1531-1614.

Chatterjee, S. and D. Corbae (1992), "Endogenous Market Participation and the General Equilibrium Value of Money," *Journal of Political Economy* 100, 615-646.

De Gregorio, J., P. Guidotti and C. A. Vegh (1998), "Inflation Stabilization and the Consumption of Durable Goods," *Economic Journal* 108, 105-131.

Eckstein, Z. and L. Leiderman (1991), "Seigniorage and the Welfare Cost of Inflation: Evidence from an Intertemporal Model of Money and Consumption," mimeo (Tel-Aviv University).

Flood, R. P. and P. M. Garber (1984), "Collapsing Exchange Rate Regimes: Some Linear Examples," *Journal of International Economics* 17, 1-13.

Giovannini, A. (1985), "Saving and the Real Interest Rate in LDCs," *Journal of Development Economics* 18, 197-217.

Grossman, S. and L. Weiss (1983), "A Transactions-Based Model of the Monetary Transmission Mechanism," *American Economic Review* 73, 871-880.

Krugman, P. (1979), "A Model of Balance-of-Payment Crisis," *Journal of Money, Credit and Banking* 11, 311-325.

Lahiri, A. (2001), "Exchange Rate Based Stabilizations under Real Frictions: the Role of Endogenous Labor Supply," *Journal of Economic Dynamics and Control* 25, 1157-1177.

Mulligan, C. and X. Sala-i-Martin (1996), "Adoption of Financial Technologies: Implications for Money Demand and Monetary Policy," NBER Working Paper 5504.

Ostry, J. and C. Reinhart (1992), "Private Saving and Terms of Trade Shocks: Evidence from Developing Countries," *IMF Staff Papers* 39, 495-517.

Rebelo, S. T. and C. A. Vegh (1995), "Real Effects of Exchange Rate-Based Stabilization: an Analysis of Competing Theories," in B. S. Bernanke and J. J. Rotemberg, eds., NBER Macroeconomics Annual (MIT Press, Cambridge, MA) 125-174.

Reinhart, C. M. and C. A. Vegh (1995), "Nominal Interest Rates, Consumption Booms, and Lack of Credibility: a Quantitative Examination," *Journal of Development Economics* 46, 357-378.

Rossi, N. (1988), "Government Spending, the Real Interest Rate, and the Behavior of Liquidity-constrained Consumers in Developing Countries," *IMF Staff Papers* 35, 104-140.

Rotemberg, J. (1984), "A Monetary Equilibrium Model with Transactions Costs," *Journal of Political Economy* 92, 40-58.

Vegh, C. A. (1992), "Stopping High Inflation: an Analytical Overview," *IMF Staff Papers* 39, 626-695.

Figure 1

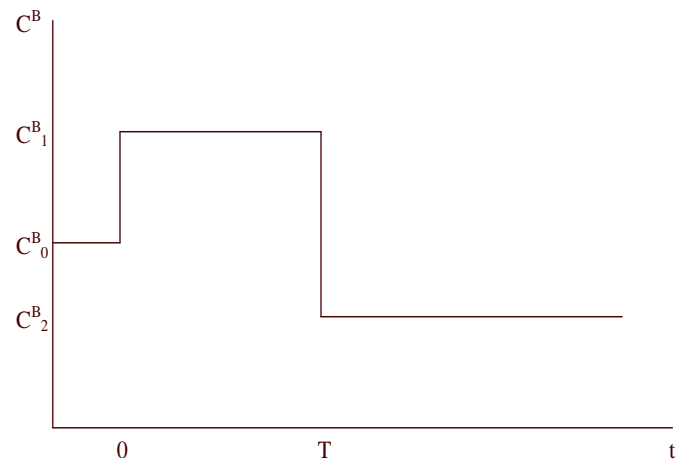
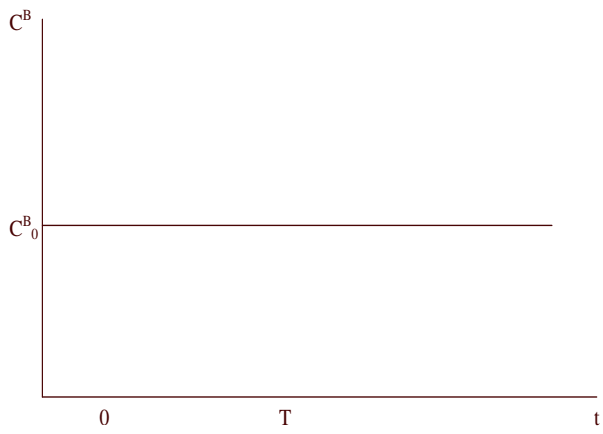
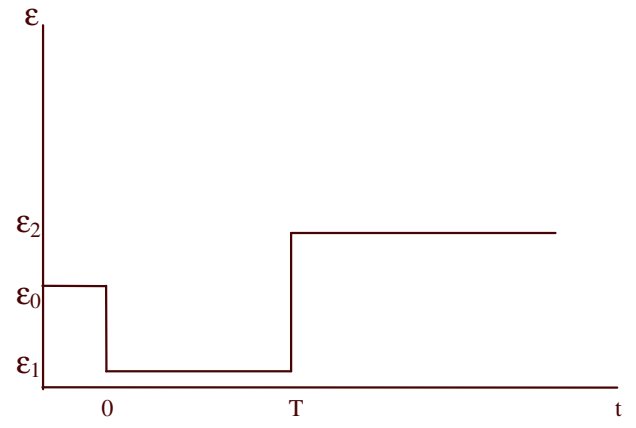
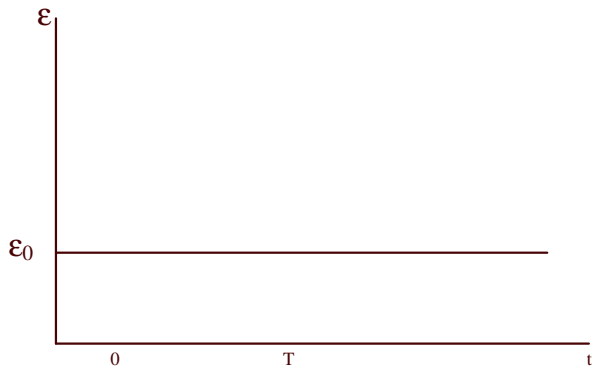


Figure 2

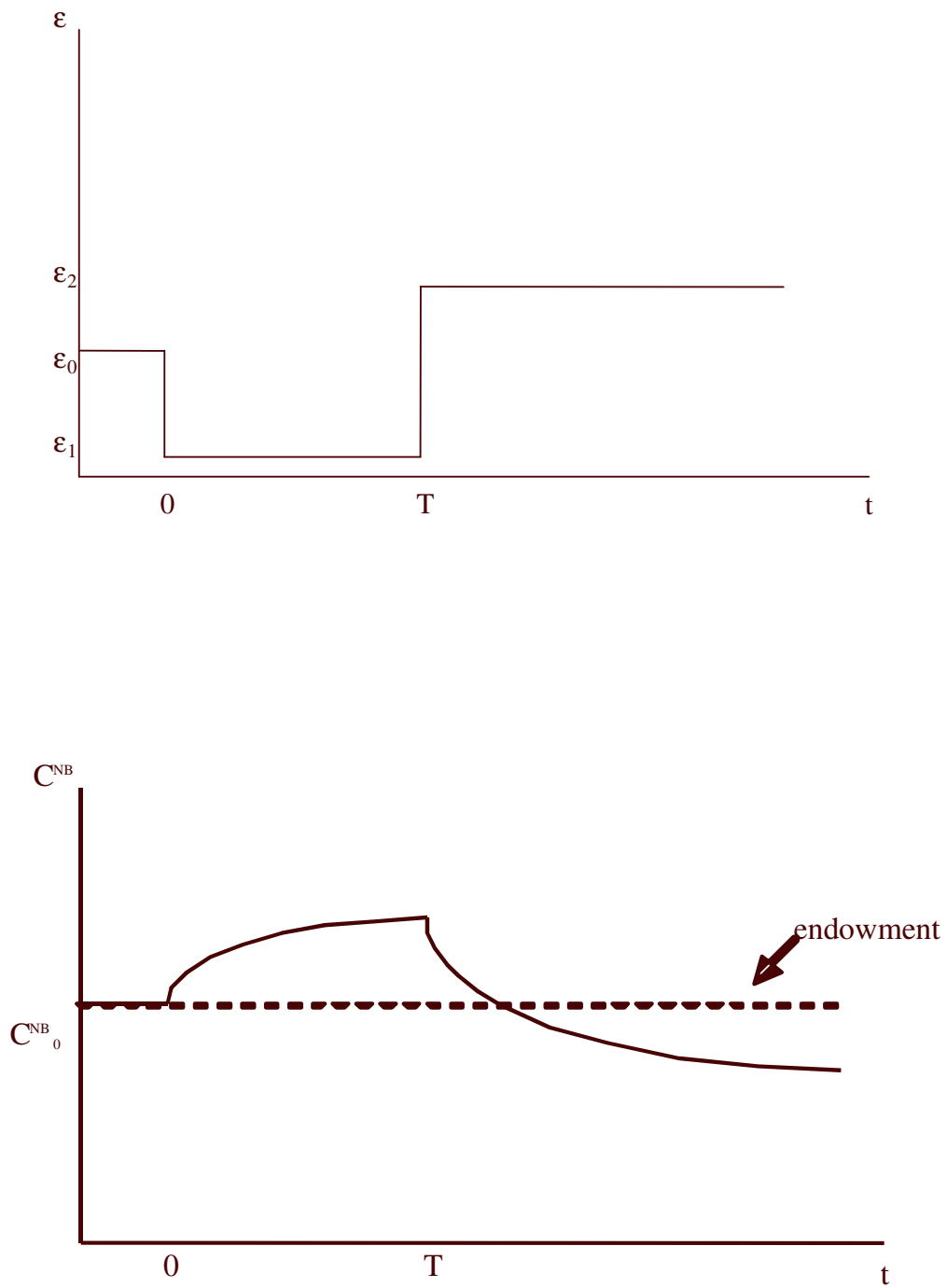


Figure 3

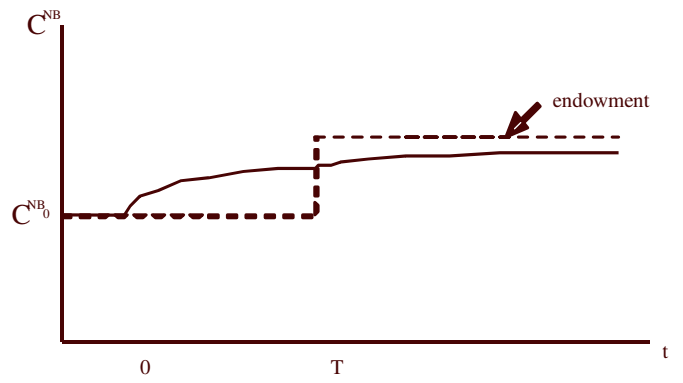
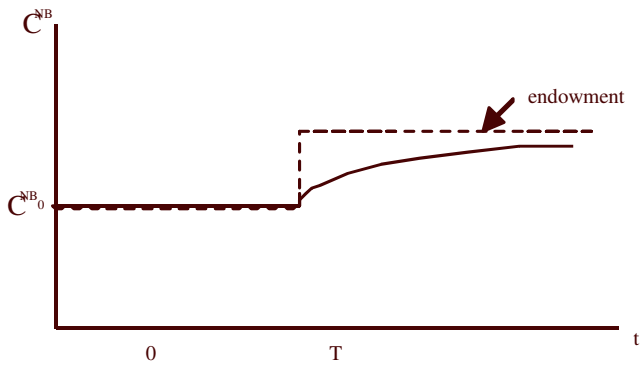
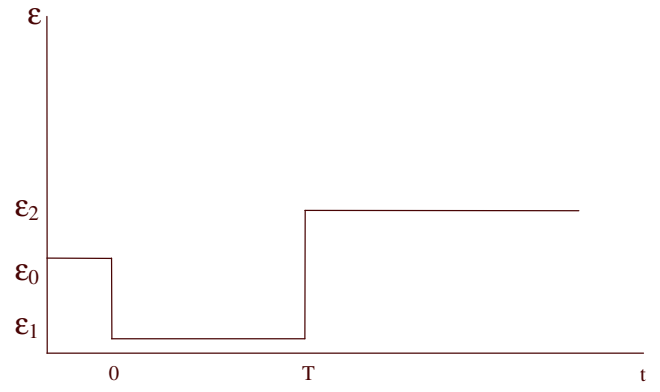
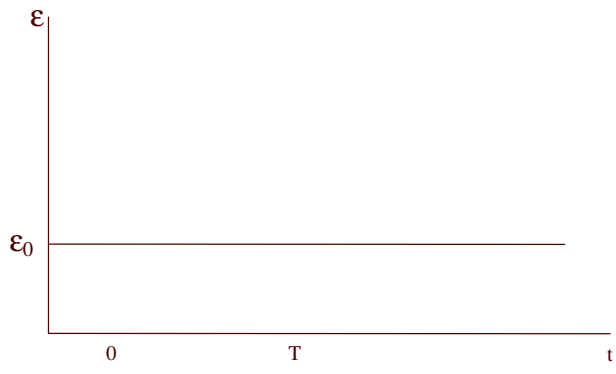


TABLE 1

Program	Begin and end date	Did the program end in crisis?	Is there a strong resurgence of inflation after the program?*
Brazil 1964	03/1964 – 08/1968	No	No
Argentina 1967	03/1967 – 05/1970	Yes	Yes
Uruguay 1968	06/1968 – 12/1971	Yes	Yes
Chilean Tablita	02/1978 – 06/1982	Yes	No
Uruguayan Tablita	10/1978 – 11/1982	Yes	Yes
Argentine Tablita	12/1978 – 11/1981	Yes	Yes
Austral (Argentina)	06/1985 – 09/1986	Yes	Yes
Cruzado (Brazil)	02/1986 – 11/1986	Yes	Yes
Mexico 1987	12/1987 – 12/1994	Yes	No
Uruguay 1990	12/1990 – 01/2002	Yes	No
Convertibility (Argentina)	04/1991 – 01/2002	Yes	No
Real (Brazil)	07/1994 – 01/1999	Yes	No

Source: Calvo and Vegh (1998) and International Financial Statistics (IMF)

* With the exception of Uruguay, 1968, for all other plans for which we observe a strong resurgence in inflation, the new increase in price level has surpassed the original one. For the other cases, we observe an increase in inflation after the plan, but to less than one third of the level of the pre-program inflation. Also, in all these programs that were able to lower inflation, we observe a significant fiscal adjustment.

TABLE 2 **$\lambda = 0.05$**

	$\sigma = 0.1$	$\sigma = 0.3$	$\sigma = 0.5$	$\sigma = 0.99$	$\sigma = 2$
$\Delta\% \text{ p. v. } c^{\text{NB}}$	-0.011	-0.017	-0.024	-0.039	-0.074
$\Delta\% \text{ p. v. } c^{\text{B}}$	0.216	0.329	0.445	0.738	1.390
$\Delta\% \text{ welf. NB}$	4.962	1.448	0.816	0.370	0.125
$\Delta\% \text{ welf B}$	0.186	0.238	0.291	0.424	0.712
ε_2	0.4128	0.4130	0.4132	0.4137	0.415

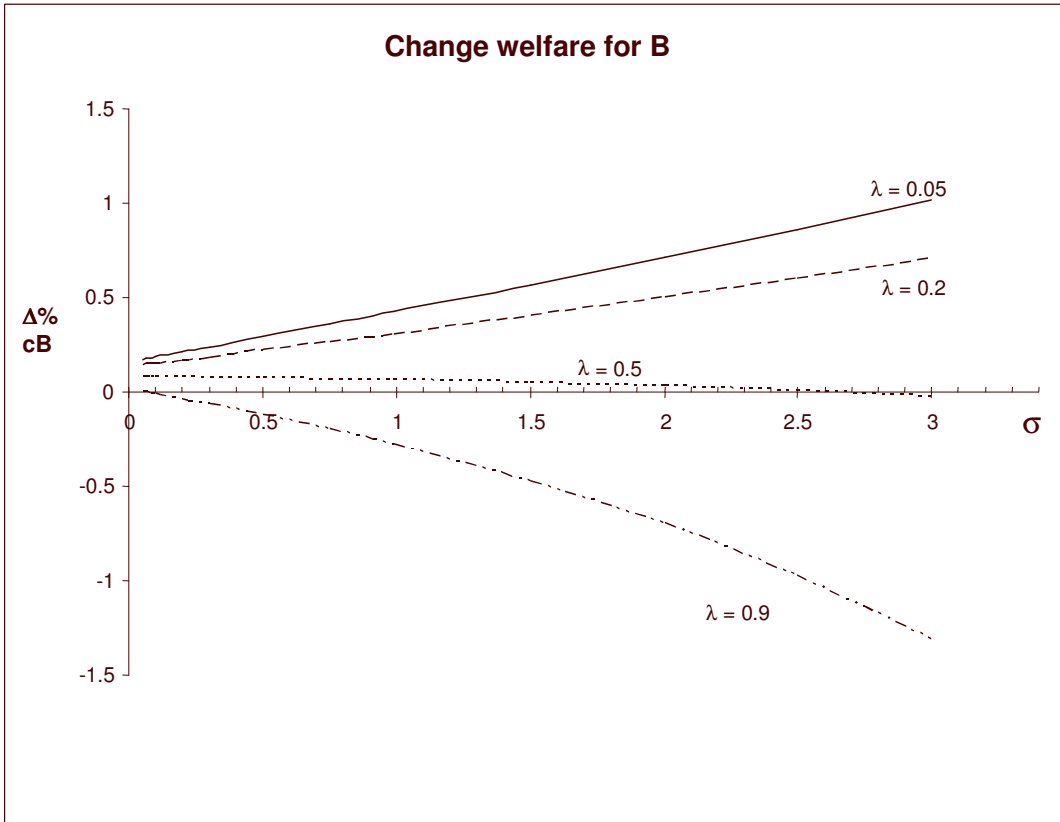
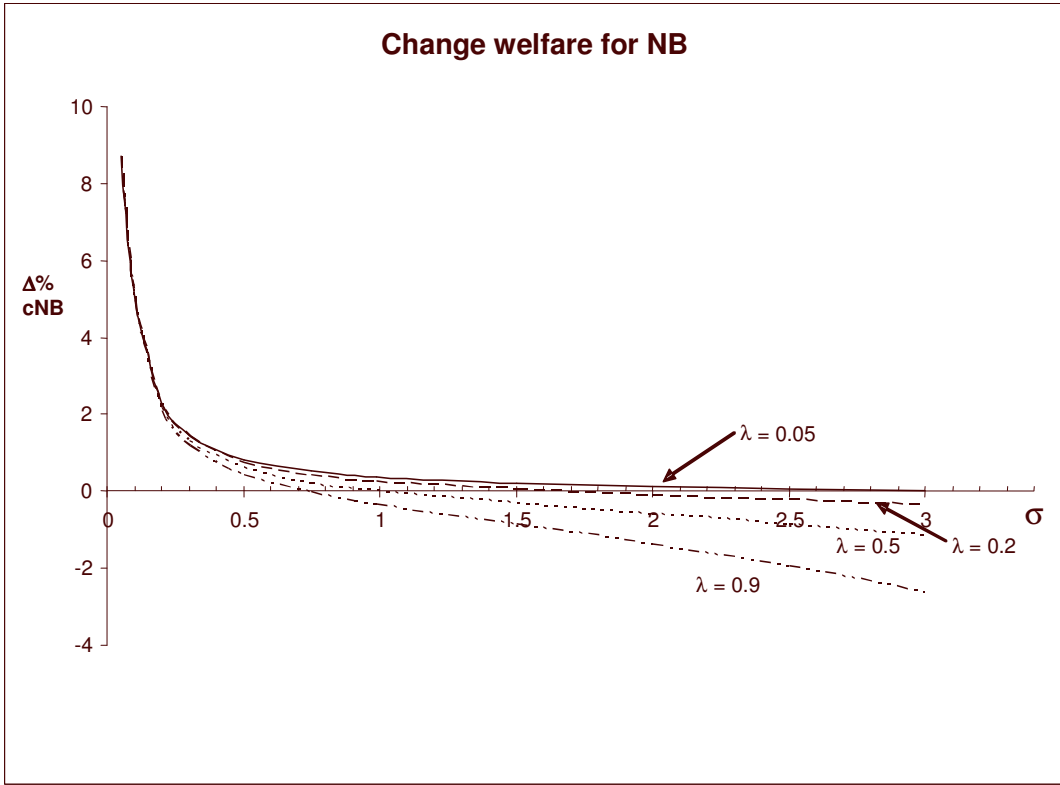
 $\lambda = 0.5$

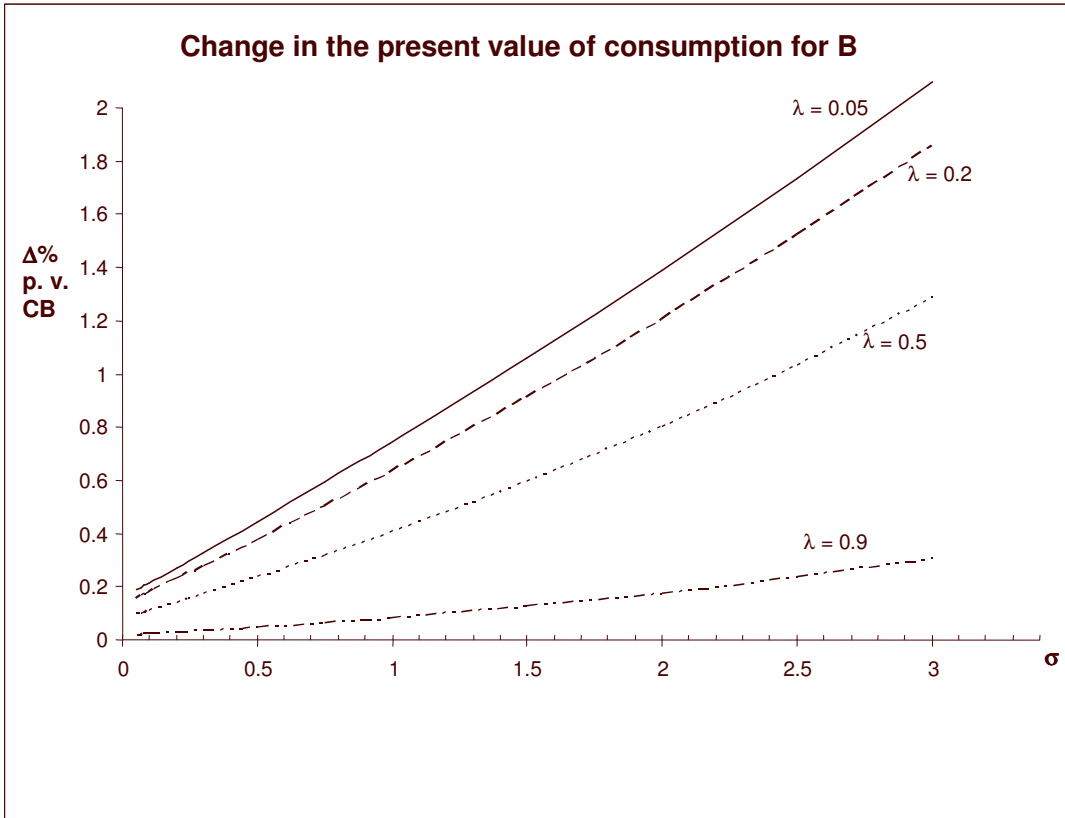
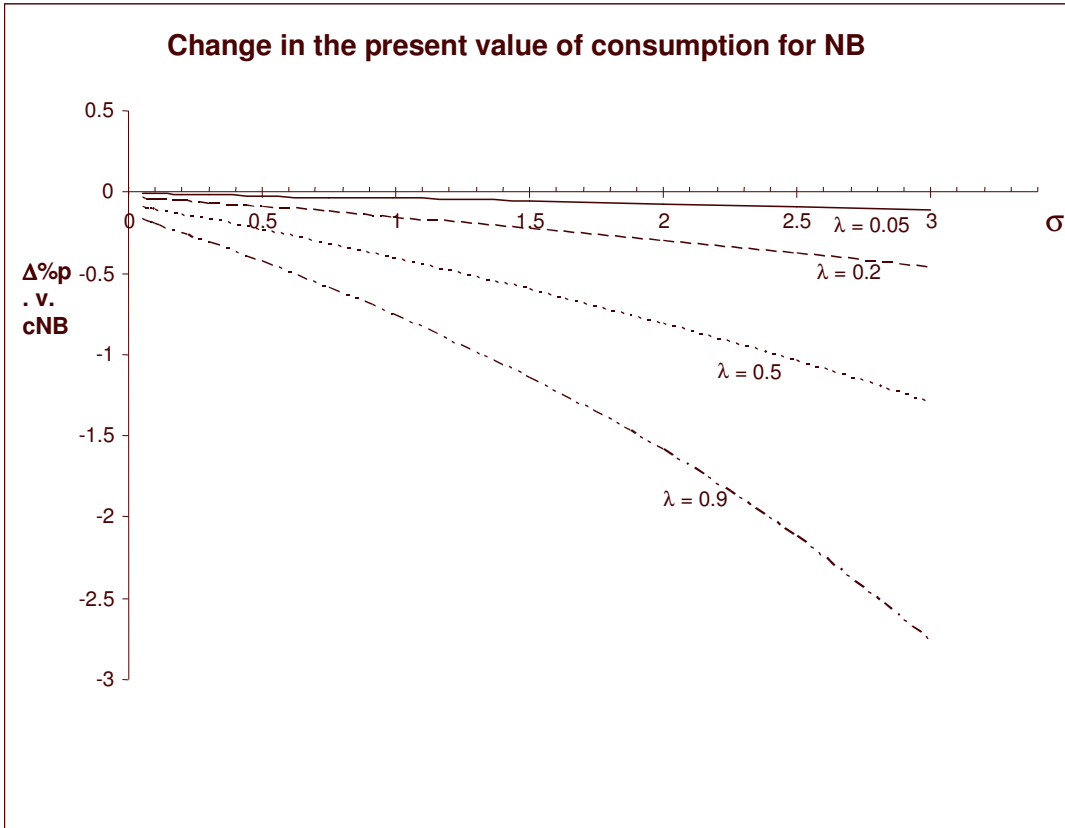
	$\sigma = 0.1$	$\sigma = 0.3$	$\sigma = 0.5$	$\sigma = 0.99$	$\sigma = 2$
$\Delta\% \text{ p. v. } c^{\text{NB}}$	-0.111	-0.173	-0.237	-0.405	-0.806
$\Delta\% \text{ p. v. } c^{\text{B}}$	0.111	0.172	0.236	0.403	0.802
$\Delta\% \text{ welf. NB}$	4.898	1.304	0.610	0.009	-0.604
$\Delta\% \text{ welf B}$	0.079	0.077	0.074	0.063	0.030
ε_2	0.4227	0.4247	0.4268	0.4323	0.4456

 $\lambda = 0.9$

	$\sigma = 0.1$	$\sigma = 0.3$	$\sigma = 0.5$	$\sigma = 0.99$	$\sigma = 2$
$\Delta\% \text{ p. v. } c^{\text{NB}}$	-0.195	-0.309	-0.430	-0.754	-1.587
$\Delta\% \text{ p. v. } c^{\text{B}}$	0.022	0.034	0.048	0.083	0.176
$\Delta\% \text{ welf. NB}$	4.842	1.177	0.424	-0.336	-1.383
$\Delta\% \text{ welf B}$	-0.011	-0.065	-0.123	-0.281	-0.700
ε_2	0.4313	0.4351	0.4391	0.4498	0.4778

Parameters: $\tau^{\text{B}} = 2$; $\tau^{\text{NB}} = 2$; $y^{\text{L}} = 10$; $y^{\text{H}} = 13$; $\alpha = 0.5$; $h_0 = 0$; $b_0 = 0$; $T = 4$; $r = 0.07$





Change in ε_2

