La Macroeconomía de los Controles Cambiarios

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The Macroeconomics of Exchange Controls: Distortions, Resource Allocation, and Crisis Timing

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Abstract

Exchange controls are a common policy tool in emerging economies. This study develops a model with capital accumulation to formalize their macroeconomic consequences in an environment where the government finances its deficit through domestic credit expansion while maintaining a fixed exchange rate. The analysis shows that exchange controls generate a wedge between official and parallel exchange rates, reduce official exports and permanent consumption, and, under certain conditions, tighter import restrictions can increase money demand and delay the collapse of the fixed rate regime. When import restrictions are endogenously adjusted in response to the amount of legal exports, domestic prices rise persistently over time.
The main contributions are: (i) formalizing and summarizing the effects of exchange controls in a tractable model with capital accumulation and monetized deficits under a fixed exchange rate, and (ii) identifying a money-demand channel through which import restrictions can influence the timing of a first generation balance-of-payments crisis.

JEL Codes: F31, F32, F41.
Keywords: Exchange controls, balance-of-payments crises, parallel markets, import restrictions, money demand, crisis timing.

I Introduction

Dual or multiple exchange rate regimes with parallel markets are more prevalent than commonly recognized. Reinhart and Rogoff (2004) document that such arrangements have been a persistent feature of the international monetary system, especially in developing and emerging economies. More recently, Schmitt-Grohé and Uribe (2023) estimate that approximately 20 percent of countries operate under dual or multiple exchange rates. Reinforcing this point, Malpass (2023) reports that, as of March 31, 2023, 24 emerging and developing economies (EMDEs) maintained parallel exchange rates in conjunction with capital controls [1]. In more than half of these cases, the premium between the official and market exchange rates exceeded 10 percent as the following table shows.

Table 1: Exchange rate premiums on March 31, 2023, Malpass (2023)

Country	**Rate Premium (%)**	**Country**	**Rate Premium (%)**
Lebanon	616.7	Congo, Democratic Republic	14.1
Yemen	392.0	Angola (as of 01/27/2023)	11.1
Syria	150.4	Bangladesh	6.9
Iran	1195.2; 90.9[2]	Lao PDR (as of 02/28/2023)	6.8
Argentina	87.1	Ghana	6.7
Ethiopia	84.1	Libya	6.2
Zimbabwe	72.1	Mozambique	4.4
Burundi (as of 12/31/2022)	63.0	Ukraine	3.2
Nigeria	61.7	Sri Lanka	2.8
Argelia	53.5	Sudan	2.6
Malawi	45.4	Venezuela	0.9
Myanmar	36.0	South Sudan	-0.2

[1]For further details on the exchange rate arrangements of these countries, see the International Monetary Fund's AREAER (2023).

[2]There are two official exchange rates in Iran.

Parallel markets typically emerge as a consequence of exchange controls, which are often implemented to stabilize currency markets, preserve foreign reserves, or generate fiscal revenues. However, these measures distort relative prices, misallocate resources, encourage rent-seeking behavior, and reduce economic efficiency. In particular, they can undermine the productive capacity of the economy and hinder long-term growth.

While the literature has largely focused on the economic costs of exchange controls, relatively little attention has been paid to their potential to delay the onset of a balance-of-payments crisis. This study is set in an environment characterized by an unsustainable fiscal and monetary policy mix, in which a first-generation balance-of-payments crisis is bound to occur in the absence of adjustment. The objective is to examine the economic effects of exchange controls on exports, consumption, money demand, and the timing of the crisis.

To that end, I develop a stylized model featuring a neoclassical production function and a parallel exchange market. The introduction of exchange controls generates several core predictions: (i) a persistent wedge between the official and parallel exchange rates; (ii) a decline in both exports and permanent consumption; and (iii) under certain conditions, tighter import restrictions raise money demand temporarily, which can postpone the timing of the balance of payments crisis. In addition, it is shown that the share of smuggled exports rises with the exchange rate gap and that under an automatic adjustment of import restrictions policy, exchange controls loose their ability to control domestic inflation.

The main contributions of this work are twofold. First, it formalizes and summarizes the effects of exchange controls in a tractable model with capital accumulation and monetized deficits under a fixed exchange rate. Second, it highlights a novel mechanism by which tightening import restrictions could temporarily postpone balance-of-payments crises through their effect on money demand.

The remainder of the study is organized as follows. Section II reviews the main findings from the existing literature. Section III presents the theoretical model. Part 1 describes the behavior of an economy in the absence of

exchange controls. Part 2 introduces exchange controls and analyzes their effects on key macroeconomic variables. Part 3 examines how these controls influence the timing of the crisis. It also presents an estimated money demand model to assess, from an empirical perspective, the effect of tightening import restrictions on the timing of regime collapse. Section IV concludes. Lastly, part A of the appendix examines the implications of an automatic import restrictions policy in response to the amount of official exports.

II Literature Review

There is a wide range of literature on exchange controls and related macroeconomic policies. To ground the discussion, it is useful to first outline how these controls typically operate and the distortions they generate.

Exchange controls operate by centralizing the supply of foreign currency and restricting access to it through administrative mechanisms in order to keep the official exchange rate stable. When the demand for foreign currency exceeds the limited supply available at the official exchange rate, a parallel market typically emerges. In this market, individuals may be willing to pay a higher price to obtain foreign currency, giving rise to a parallel exchange rate that deviates from the official one. Consequently, many countries that implement exchange controls experience persistent exchange rate gaps between the official and parallel markets.

Agénor (1990) points out that the supply of foreign currency in the parallel market has its source in under-invoicing of exports (which as Reinhart and Rogoff (2004) indicate, increases with the exchange rate gap), over-invoicing of imports, foreign tourists, and diversion of remittances through nonofficial channels. Demand for parallel foreign currency is determined in part by illegal imports (incentivized by the imposition of tariffs and quotas that tighten as a result of the exchange controls), portfolio diversification, capital flight, and residents' travel abroad.

In economies with exchange controls the government forces exporters to convert their foreign currency earnings to local currency at an official exchange rate that is commonly not convenient when compared to the parallel ex-

change rate. For that reason, Mosquera and Sturzenegger (2021) claim that exchange rate controls act as a tax on exports and may act as a subsidy to imports. Schmitt-Grohé and Uribe (2023) further explain that, as the exchange rate gap widens, the import subsidy increases, but the official number of imports decline due to tightening government restrictions. As a result, the economy is forced to operate with less imported inputs of production, which represents a misallocation of resources. This resource misallocation is then translated into lower levels of consumption. The economy also becomes more reliant on domestic factors.

Additionally, a decline in competitiveness occurs, since the increase in the cost of imported materials due to import restrictions deteriorates the terms of trade.

These distortions also weigh on long-run growth. In part, the slower growth is explained by size of the parallel premium, as Kiguel and O'Connell (1995) indicate. They also point out that fiscal deficits are positively correlated with the average parallel premium. High deficits produce rapid money growth which, in turn, produces high premiums. Moreover, exchange rate gaps may induce rent-seeking and corruption, since large gaps generate substantial rents for those with access to official foreign exchange.

From the point of view of the authority, Agénor (1992) explains that underinvoicing exports and a reduction of legal imports imply a loss of tariff revenue for the government.

The persistent usage of exchange controls despite their well-documented negative effects raises the question of why governments continue to adopt them. Schmitt-Grohé and Uribe (2023) argue that exchange controls can function as a fiscal instrument, enabling governments to capture rents and alleviate external debt pressures. Similarly, Bhagwati (1978) characterizes them as an implicit tax on international trade. From this perspective, the appeal of exchange controls lies in their capacity to generate fiscal resources without the need for explicit taxation.

Additionally, exchange controls are often accompanied by multiple exchange rate regimes, which serve a range of other purposes beyond revenue generation. As Dornbusch (1986) explains, multiple exchange rates are typically

used to influence the allocation of resources, provide buffers against external shocks and manage the trade balance.

In addition to research on exchange controls, another body of work linked to exchange rates focuses on first generation balance-of-payments crises. Within this literature, particular attention has been given to the policy tools governments may use to delay such crises. This issue is especially pertinent for emerging and developing economies, which often face heightened risks when their exchange rates are under pressure. As Calvo and Reinhart (2000) show, large devaluations or depreciations in these countries frequently trigger credit crises: sovereign ratings fall, access to external financing dries up, trade suffers, and inflation pass-through from currency swings is especially pronounced. Pervasive liability dollarization (both by the public and private sectors) only amplifies these vulnerabilities. Faced with the prospect of a first generation balance-of-payments crisis and the abandonment of a peg, policymakers thus have strong incentives to defend their official rate.

The theoretical foundation for the dynamics of the first generation balance-of-payment crises comes from Krugman's (1979) seminal model, which illustrates the inherent inconsistency of a fixed-rate regime financed by domestic credit expansion: reserves run down, speculative pressure builds, and the peg ultimately collapses. Building on this framework, Lahiri and Végh (2000) demonstrate that raising interest rates within a certain range can defer the attack, while Park and Sachs (1987) show that capital controls extend the lifespan of the peg, although they fall short of preventing its eventual failure. More recently, Espino, Gauna, and Neumeyer (2023) confirmed (under both free-trade and import-restriction scenarios) that capital controls buy additional time.

Given these findings, I argue that exchange controls may under certain conditions form part of this policy toolkit: by tightening import restrictions and altering money demand, governments could postpone the onset of a balance-of-payments crisis. Yet the evidence indicates that such measures risk bringing the crisis forward.

III The Model

1 Economy Without Exchange Controls

We begin by outlining the macroeconomic environment in which exchange controls are introduced. The economy operates under a predetermined rate of devaluation (which for simplicity I assume is zero) and faces an external constraint in the form of a finite stock of international reserves. At the same time, and following Calvo (1987), the government commits to a constant real transfer to households, $s_t = \bar{s}$. I assume that the fiscal authority takes the lead in setting this policy, while the monetary authority passively accommodates by adjusting the rate of domestic credit expansion to ensure its financing. This policy mix implies that if the rate of domestic credit growth exceeds the rate of devaluation, then the government faces a gradual depletion of reserves. Once reserves are exhausted, the peg collapses and the exchange rate is allowed to float.

Given this policy framework, we consider a small open economy, fully integrated into world markets for goods and capital, inhabited by a representative individual who lives infinitely. The individual derives utility from two sources: consumption of an imported good, denoted c_t, and real money balances, m_t, with an instantaneous utility function $u(c_t, m_t)$ that is strictly increasing and strictly concave in both arguments. The consumer supplies labor to a representative firm that produces an exportable good and earns a real wage w_t. In terms of asset holdings, apart from real money balances, the agent can also save through internationally traded bonds, b_t, that yield a constant real interest rate r.

For simplicity I assume that the population doesn't grow.

1.1 The Consumer

The consumer's lifetime utility is given by:

$$U_t = \int_0^\infty u(c_t, m_t) e^{-\rho t} dt \tag{1}$$

where ρ is the rate of time preference. The real financial wealth of the individual is $a_t = m_t + b_t + k_t$.
The consumer's budget constraint is thus given by:

$$\dot{a}_t = ra_t + w_t + \bar{s} - i_t m_t - c_t \tag{2}$$

where $i_t = r + \pi_t$ is the nominal interest rate.
The consumer chooses c_t and m_t in order to maximize his lifetime utility. Solving the first order conditions and assuming that $\rho = r$, we find that the marginal rate of substitution of c_t to m_t is:

$$\frac{\dfrac{\partial u(c_t, m_t)}{\partial m_t}}{\dfrac{\partial u(c_t, m_t)}{\partial c_t}} = i_t \tag{3}$$

Notice, from (3) that, if the right-hand side of the equation drops, then a substitution effect takes place, through which consumption declines and real money holdings rise.
The consumer's intertemporal budget constraint is:

$$a_0 + \int_0^\infty (w_t + \bar{s})e^{-rt}dt = \int_0^\infty (c_t + i_t m_t)e^{-rt}dt$$

Hence, the initial financial wealth plus the present value of the consumer's income derived from his salary and the government transfers equals to the present value of the consumer's expenditures throughout his lifetime.

1.2 The Export Sector

A representative firm produces an exportable good using capital and labor under a constant returns to scale technology $Y_t^x = F(K_t, L_t)$. The production function exhibits positive and diminishing marginal products in each input, and satisfies the standard Inada conditions. The firm operates in a competitive environment, taking prices as given, and sells its output abroad.

From the first order conditions, we obtain:

$$f'(k_t) = r \tag{4}$$

$$f(k_t) - k_t f'(k_t) = w_t \tag{5}$$

Thus, the marginal products of capital and labor are equal to the respective factor price.

1.3 The Government

The government is composed of monetary and fiscal authorities. It holds a stock of international reserves R_t, defined as the difference between the monetary base (m_t) and domestic credit ($d_t = D_t/E_t$), where D_t grows at a rate μ_t. It can control the official exchange rate through the depreciation rate ε_t and, as previously stated, conducts transfers to the representative agent in the amount $s_t = \bar{s}, \forall t$.
In addition to managing the stock of reserves, the government affects macroeconomic dynamics through its decisions over money creation.
Thus, the government faces the following constraint:

$$\dot{R}_t = rR_t + \dot{m}_t + \pi m_t - \bar{s} \tag{6}$$

Working with equation (6), we derive the government's intertemporal budget constraint:

$$\int_0^\infty \bar{s}e^{-rt}dt = R_0 + \int_0^\infty (\dot{m}_t + \pi_t m_t)e^{-rt}dt \tag{7}$$

This equation shows that the government must finance the present discounted value of transfers to the individual with the initial stock of international reserves and the proceedings from the present discounted value of money creation.

1.4 Equilibrium Conditions

We define the external assets of this economy as $x_t = R_t + b_t$. Considering this and combining the constraints of the consumer and the government, we can express the following:

$$\dot{x}_t = rx_t + y_t^x - c_t - \dot{k}_t \tag{8}$$

This equation states that the net accumulation of assets by the economy is equal to the current-account balance.

By combining the government's and the consumer's intertemporal budget constraints with the first-order conditions of the consumer's maximization problem, which imply that consumption remains constant over time, we obtain the following expression for the permanent level of consumption.

$$\bar{c} = r(x_0 + k_0) + r\int_0^\infty w_t e^{-rt} dt \tag{9}$$

2 Economy with Exchange Controls

Faced with an unavoidable first-generation balance-of-payments crisis, the government introduces exchange controls in an attempt to delay the collapse of the fixed exchange-rate regime[3]. Their introduction affects the economy through two primary channels. First, it raises the effective cost of consuming imported goods, captured by the parameter ω, which reflects the severity of the import restrictions the government sets[4]. Second, it generates a gap, $\tau_t = P_t/E_t$, between the parallel and official exchange rates, effectively taxing

[3]While the setup I consider shares features with the capital controls plus import restrictions framework in Espino, Gauna, and Neumeyer (2023), my focus is on a different type of dual exchange rate regime. Specifically, rather than a reserve rationing regime, I analyze a reserves adjustment regime. Governments might opt for this arrangement under exchange controls because it was the status quo, and, as Lizondo (1991) notes, because transitioning to a rationing regime in the presence of an initial BOP deficit can lead to a widening of the spread between the official and parallel exchange rates, thereby exacerbating distortions in relative prices and allocation.

[4]In this basic setup ω is a constant. It doesn't automatically adjust to keep the current account balanced and thus limit the loss of reserves. Section A of the appendix explains how an automatic adjustment of ω to changes in the export sector would work.

the production of exportable goods. This tax increases over time as the exchange rate gap widens[5].

The exchange rate gap arises due to excess demand for foreign currency at the official rate, and the restrictions that limit legal access to foreign exchange. Assuming that the parallel exchange rate grows at a rate $\hat{P}_t = h(\mu_t - \varepsilon)$, where $h'(\cdot) > 0$, captures the idea that excess domestic credit expansion relative to money demand generates depreciation pressures in the parallel market. In the context of exchange controls and a fixed official exchange rate, this leads to a progressive widening of the parallel premium.

This assumption aligns with a well-established body of literature that connects fiscal and monetary expansions with dynamics in parallel exchange markets. Agénor (1992) explicitly observes that, under a fixed exchange rate regime, "an expansionary fiscal and credit policy generates a depreciation of the parallel exchange rate." Similarly, Kiguel and O'Connell (1995) provide empirical evidence of a positive relationship between the average parallel premium and the government fiscal deficit. They emphasize that "the tight link between fiscal deficits and money growth in many developing countries suggests that over expansionary fiscal policy is often at the heart of parallel markets with persistently high premiums." In the same vein, Werning (2013) offers an explanation linking the growth of the parallel exchange rate to sustained monetary expansion.

Figure 1 summarizes the main aspects of exchange controls discussed above. The top panel of the figure shows the dynamics in the export sector of the economy. By imposing exchange controls, the government forces exporters to convert their foreign currency earnings into local currency at the official exchange rate, which is typically unfavorable compared to the parallel market rate. Therefore, if exporters were to reconvert their earnings to foreign currency, they would be able to purchase less foreign currency at the parallel

[5]I assume that the proceeds from this tax are redistributed to households through transfers: $s'_t = \bar{s} + (1 - 1/\tau_t)y^x_{o,t}$, where $y^x_{o,t}$ denotes official exports per capita.
Mosquera and Sturzenegger (2021) adopt the same assumption, noting that the government levies a tax on exports and transfers the resulting revenues to the private sector. In this way, the proceeds from the export tax become a mechanism through which exchange controls simultaneously penalize the export sector and subsidize imports, reallocating income from exporters to domestic consumers.

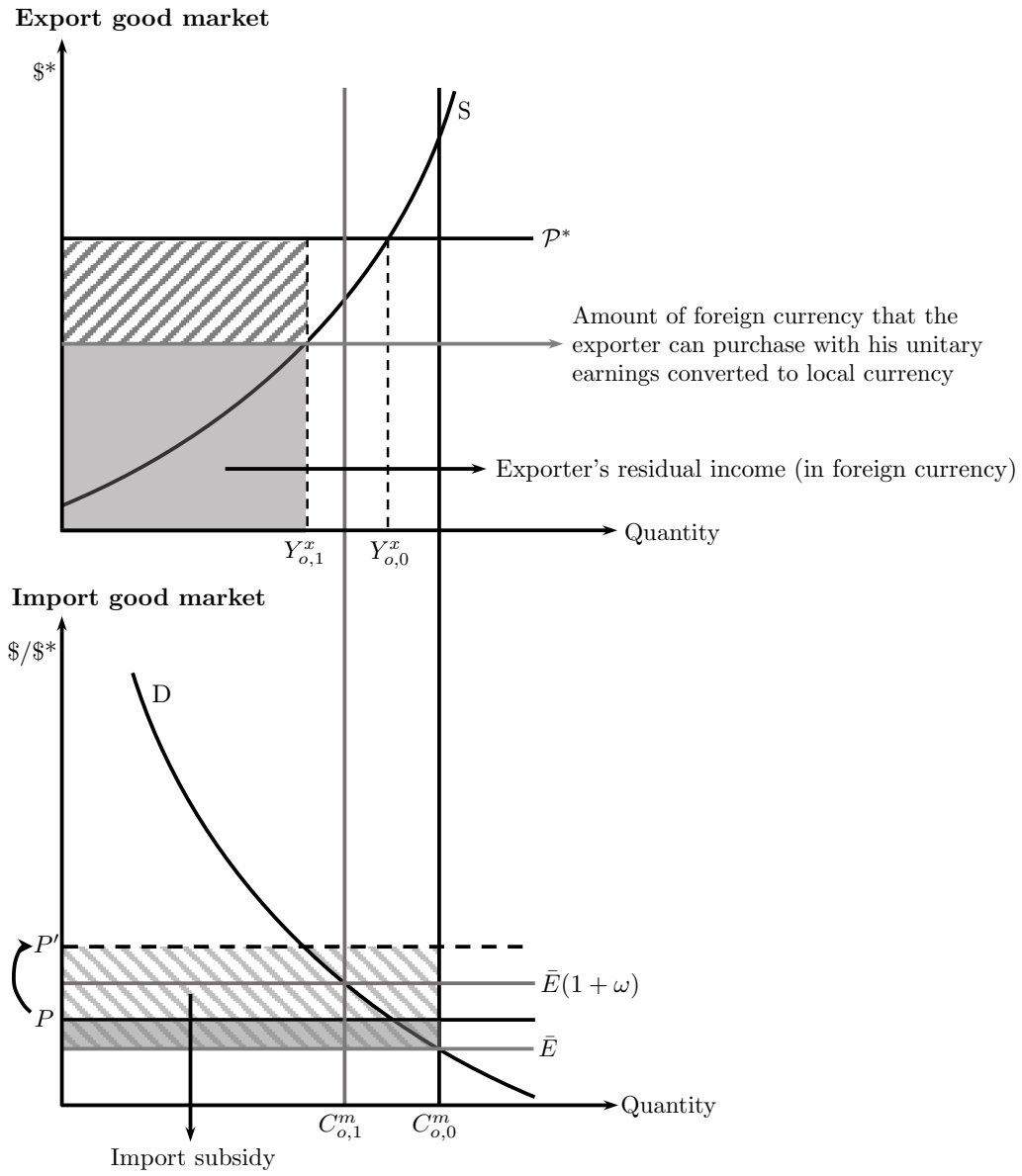

Figure 1: Effects of exchange controls on imports and exports.

rate. As the exchange rate gap widens, the amount of foreign currency the exporter can purchase with his earnings drops. As a result, official exports continuously decline. Finally, the government receives an income represented by the stripped area.

The second panel of Figure 1 illustrates the dynamics of the imported good

market under exchange controls. In this context, such controls effectively operate as a subsidy for imports. When the official exchange rate is fixed below the market-clearing level, foreign goods become artificially cheap, making imports more attractive. As the parallel exchange rate depreciates the subsidy increases —this dynamic is reflected in the figure with the increase of the parallel exchange rate from P to P'. However, exchange controls are often implemented alongside import restrictions, which mitigate this effect. In the case depicted, the restrictions captured by ω increase the cost of importing, thereby reducing import volumes when compared to a simple fixed exchange rate scenario. The restrictions thus offset part of the effect of the subsidy and limit the amount of imports.

The graph also displays the behavior of the trade balance. From the first panel we've seen that official exports continuously fall alongside the rise of the exchange rate wedge. On the import's side, even though the restrictions captured by ω limit the amount purchased, the fact that, under this simplified set up, ω remains constant (and since the exchange rate is fixed and international prices are assumed to remain unchanged) gives that the level of consumption of imported goods will remain constant. As a result, as time goes on, the trade balance deficit grows, and with it reserves decline.

In this initial model we abstract from what happens with smuggled imports.

2.1 The Consumer

In an economy with exchange controls, the budget constraint for the individual is:

$$\dot{a}_t = ra_t + w_t + s'_t - i_t m_t - (1+\omega)c_t \tag{10}$$

Notice that the parameter ω appears multiplying the consumption of the imported good, reflecting the additional cost of acquiring it due to the administrative barriers and penalties the government imposes.

Maximizing (1) subject to (10) gives:

$$\frac{\frac{\partial u(c_t, m_t)}{\partial m_t}}{\frac{\partial u(c_t, m_t)}{\partial c_t}} = \frac{i_t}{1+\omega} \tag{11}$$

From this, we deduce that compared to the case where $\omega = 0$, the demand for money has increased. This happens because the marginal rate of substitution between m_t and c_t is now lower than before, meaning a substitution effect has occurred due to the introduction of exchange controls[6].
The consumer's intertemporal budget constraint is:

$$a_0 + \int_0^\infty (w_t + s_t')e^{-rt}dt = \int_0^\infty [(1+\omega)c_t + i_t m_t]e^{-rt}dt$$

2.2 The Export Sector

Following the introduction of exchange controls, the firm's profit-maximization problem changes along two margins. First, the government taxes legal exports. Second, it raises the cost of capital by making the imported input more expensive via administrative restrictions. However, the imported input can be purchased at the more favorable official exchange rate.
Beyond choosing capital per worker, the firm must also decide what fraction of its total output to export through official channels and what fraction to under-invoice. Under-invoicing might be attractive because foreign-currency receipts can be converted at the parallel exchange rate. However, it entails a penalty that captures the probability of detection and the associated fine. The firm chooses the shares of official and smuggled exports, together with the stock of capital per worker, in order to maximize profits. Thus, the firm maximizes

$$\Pi_t^x = E_t \sigma_{o,t}^x f\left(\frac{k_t}{1+\omega}\right) + P_t \sigma_{s,t}^x f\left(\frac{k_t}{1+\omega}\right) - rE_t k_t - w_t - P_t C\left[\sigma_{s,t}^x f\left(\frac{k_t}{1+\omega}\right)\right]$$

subject to

[6]Note that equations (3) and (11) are comparable since the assumption that ω is constant implies that there is no inflation in this economy and thus, the nominal interest rate remains unchanged.

$$\sigma^x_{o,t} + \sigma^x_{s,t} = 1; \quad 0 \leq \sigma^x_{s,t} \leq 1$$

where $\sigma^x_{o,t}$ denotes the share of official exports, $\sigma^x_{s,t}$ denotes the share of smuggled exports and $C(\cdot)$ is the penalty for being caught smuggling exports[7]. Solving the problem yields the following conditions[8]:

$$1 - \frac{1}{\tau_t} = C'(y^x_{s,t}) \tag{12}$$

and,

$$f'(\cdot) = r(1 + \omega) \tag{13}$$

Since the left-hand side of (12) increases over time, the right-hand side must also rise. Given the shape of the cost function, this implies that smuggled exports grow over time.

This highlights an implication of exchange controls: as long as a wedge persists between official and parallel exchange rates, and enforcement remains imperfect, evasion through informal export channels is not only possible but rational from the firm's perspective.

Equation (13) states that the marginal productivity of capital must equal its factor cost. It also shows that total exports fall permanently as a consequence of exchange controls, and it allows us to trace the dynamics of official and under-invoiced exports. From the previous result we know that $y^x_{s,t}$ increases over time. Since the right-hand side of (13) is constant, the amount of official exports must continuously drop to offset the increase in smuggled exports[9]. This decline is critical because only official exports generate the foreign reserves the government requires to finance imports.

[7]Since both the probability of detection and the severity of punishment are likely to rise with the volume of smuggled exports, the expected marginal cost of smuggling is positive and increasing in $y_{s,t} = \sigma^x_{s,t} f(\cdot)$

[8]It can be shown that all the Lagrange multipliers must equal zero when the parallel exchange rate is greater than the official exchange rate.

[9]Notice that the result of total exports being constant after the imposition of exchange controls is a consequence of the assumption of constant import restrictions. If we let ω adjust to the amount of official exports, we get that total exports also drop over time.

Figure 2 illustrates the trajectory of per capita official, smuggled and total exports, with t_0 marking the imposition of exchange controls. The figure shows how official exports steadily contract, reflecting the long-run costs of the policy.

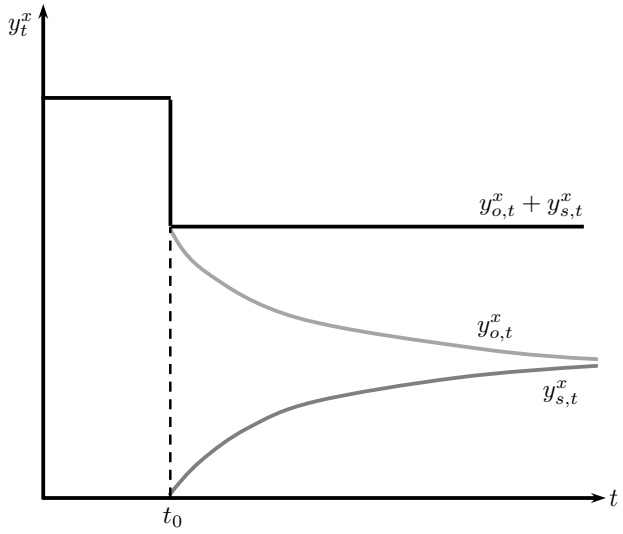

Figure 2: Trajectory of official, smugled and total exports before and after exchange controls.

2.3 The Government

Considering that the government receives additional income through the exports tax and that it hands it over to the individual, we have that equation (6) becomes:

$$\dot{R}_t = rR_t + \dot{m}_t + \pi_t m_t - s'_t + \left(1 - \frac{1}{\tau_t}\right) y_{o,t}^x \tag{14}$$

Because export tax revenues are fully transferred to consumers, and import restrictions generate no additional fiscal income, the intertemporal budget constraint in equation (7) remains unchanged.

2.4 Equilibrium Conditions

By combining (10) and (14) we obtain:

$$\int_0^\infty (1+\omega)c_t e^{-rt}dt = x_0 + k_0 + \int_0^\infty \left[w_t + \left(1 - \frac{1}{\tau_t}\right) y_{o,t}^x\right] e^{-rt}dt$$

From the first-order condition of the consumer's problem, we obtain that consumption remains constant across periods. Therefore, the permanent level of consumption is given by:

$$\bar{c} = \frac{r(x_0 + k_0) + r\int_0^\infty I_t e^{-rt}dt}{1+\omega} \tag{15}$$

where $I_t = w_t + y_{o,t}^x(1 - 1/\tau_t)$ is what the individual earns from labor and what the government returns from the tax revenue.

Compared to the case without controls, equation (15) shows that consumption falls due to the direct increase in the effective cost of imports (ω) and, potentially, due to changes in I_t caused by the distortionary impact of the export tax on wages and output[10].

For now, we assume that the direct effect of ω dominates in the consumption trajectory, and thus, the permanent level of consumption declines as the following graph shows.

The impact on real money balances is more nuanced: if the substitution effect, whereby higher import costs make holding money relatively more attractive, dominates, then money demand rises. However, if the income effect resulting from the overall contraction in consumption prevails, then money demand may instead fall. The net outcome depends on the relative strength of these two opposing forces.

Lastly, the evolution of the trade balance is driven by the fact that legal exports decline steadily over time. Although input and consumption imports also decrease, they remain constant after the imposition of exchange controls in this simplified setup. Consequently, as official exports approach zero, the trade balance deteriorates and the government loses reserves.

[10]The effect of the exchange controls on I_t depends on the sign of the following derivative.

$$\frac{\partial I_t}{\partial \omega} = \frac{\partial w_t}{\partial \omega} + \frac{\tau_t'(\omega)}{\tau_t(\omega)^2} y_{o,t}^x + \left(1 - \frac{1}{\tau_t(\omega)}\right) \frac{\partial y_{o,t}^x}{\partial \omega} \tag{16}$$

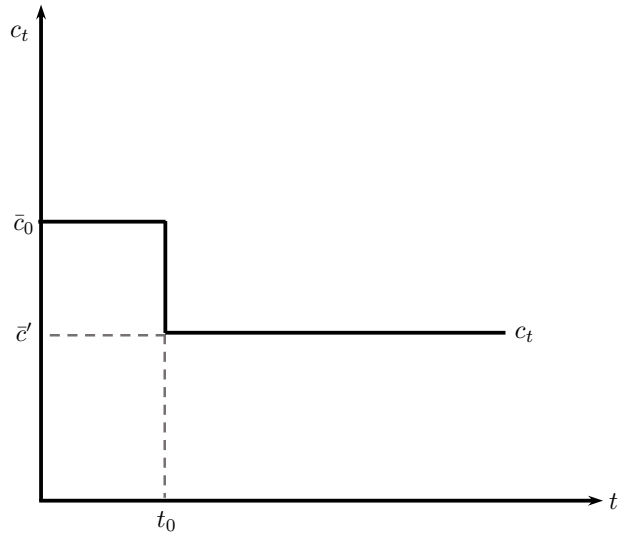

Figure 3: Trajectory of consumption before and after exchange controls.

2.5 Changes in ω

A tightening of import restrictions (modeled as an increase in the parameter ω) produces several effects on household behavior and macroeconomic aggregates.

To understand the macroeconomic effects of tightening import restrictions, we begin by recalling equation (11) from the consumer's problem. Equation (11) shows that an increase in ω reduces the right-hand side, lowering the cost of holding money relative to consumption. This generates a substitution effect: money demand rises while consumption declines. At the same time, because money demand is positively related to consumption, and higher import costs may reduce the permanent level of consumption, an income effect emerges that pushes money holdings downward. The overall impact on real money balances therefore depends on the relative strength of these two effects.

To explore the implications of this ambiguity, we consider two stylized scenarios. We can link these scenarios to the direction in which the exchange rate gap τ_t responds to changes in import restrictions. The basic mechanism operates through money demand: if tighter restrictions (i.e., an increase in ω) lead to higher money demand, then pressure is released from the parallel

market. This reduction in pressure temporarily eases excess demand for foreign exchange, which leads to a narrowing of the exchange rate gap. Formally, this corresponds to $\partial\tau_t/\partial\omega < 0$. In this case, since the premium declines, the implicit tax on official exports is temporarily reduced, which mitigates its contraction. Conversely, the fall in the exchange rate gap reduces the incentive to smuggle exports.

If money demand falls following an increase in ω, the public seeks to convert more domestic currency into foreign assets, increasing pressure on the parallel market. As a result, the gap τ_t widens further, or $\partial\tau_t/\partial\omega > 0$. This intensifies the distortion on official exports and accelerates its decline. The incentive to smuggle rises in this scenario.

The analysis now turns to a separate examination of each case.

Case 1: Increase in Money Demand.

If the substitution effect dominates, m_t rises in response to a higher ω. The resulting increase in money demand narrows the gap between the official and parallel exchange rates. A lower premium implies a reduction in the legal export tax, which might produce a rise in official exports despite the drop in overall exports as a consequence of the higher marginal cost of capital.

At first glance, the sign of equation (16) is indeterminate. However, under the reasonable assumption that the direct effect of tighter import restrictions dominates, it follows that consumption declines as import restrictions are tightened.

Figure 4 illustrate the behavior of the variables just mentioned.

Case 2: Decline in Money Demand.

If the income effect dominates, the opposite occurs. A tightening of restrictions leads to a decline in money demand. Consequently, the gap between the official and parallel exchange rates grows, which is captured by the fact that $\partial\tau_t/\partial\omega > 0$ in this scenario. This, in turn, implies that the tax to official exports increases, causing an immediate fall in legal exports. Overall exports also decline in this scenario as the marginal product of capital rises because of the tighter import restrictions.

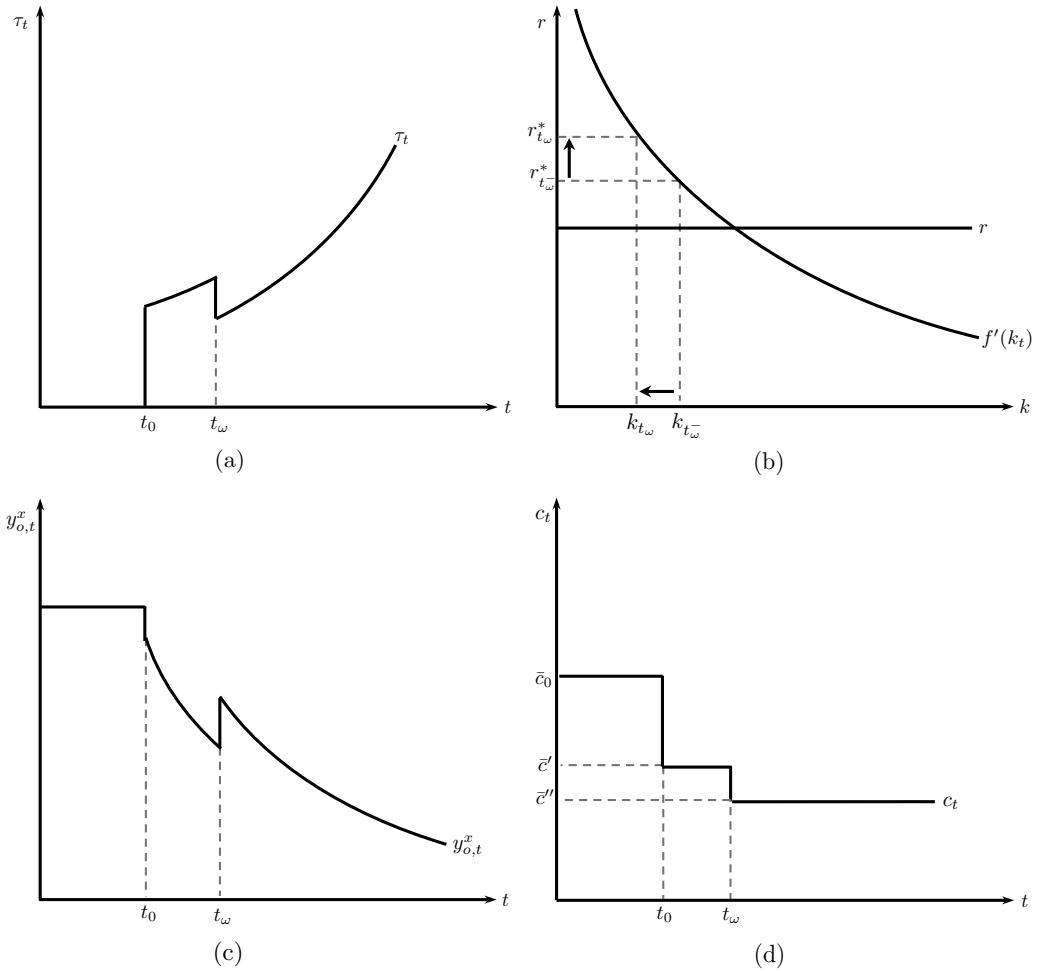

Figure 4: Dynamics of key variables after an increase in import restrictions that increases money demand.

In this case consumption has to drop, since the income effect has to outweigh the substitution effect for money demand to fall. Thus, regardless of the sign of equation (16), we know that the permanent level of consumption declines when import restrictions are tightened.

Figure 5 illustrates the behavior of the cited variables.

In this scenario, the effect of a tightening of restrictions is clearly negative. By doing so, the government fails to increase money demand and causes a further drop in consumption, accompanied by a sharper fall on official exports.

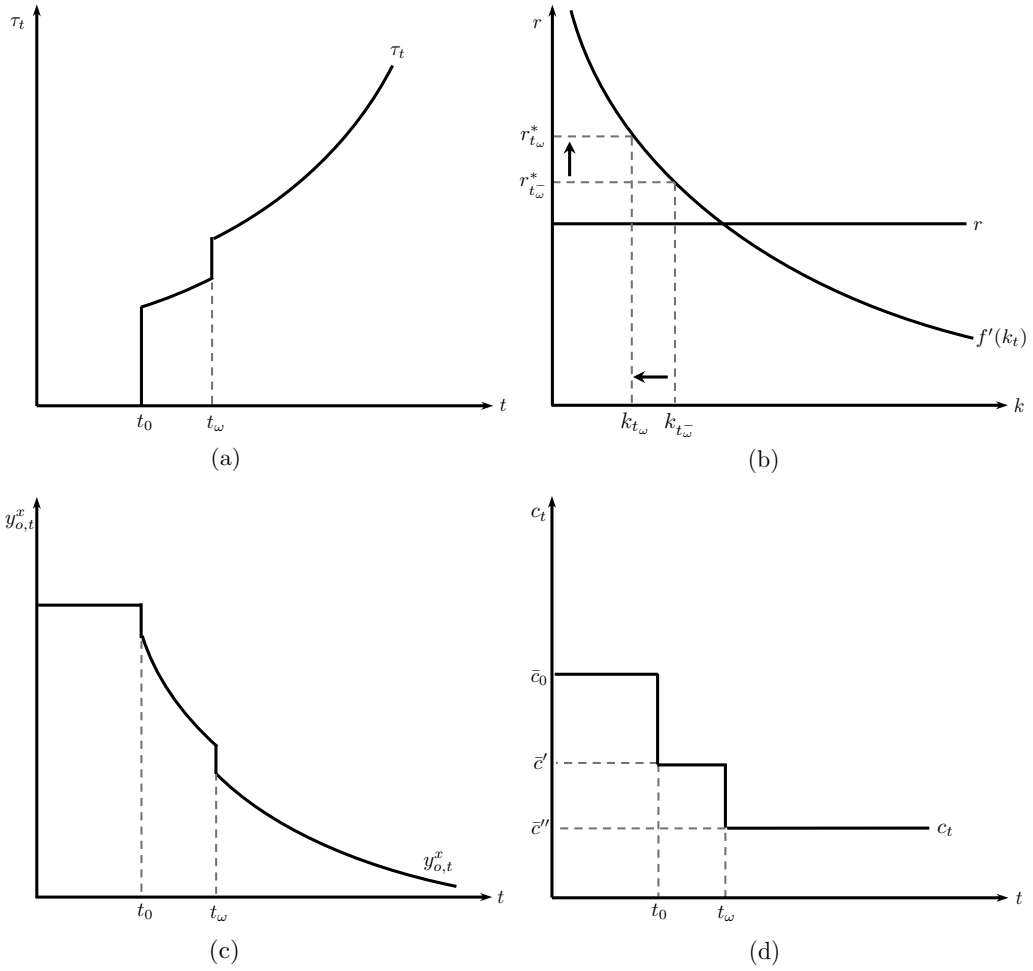

Figure 5: Dynamics of key variables after an increase in import restrictions that reduces money demand.

2.6 Lifting the Exchange Controls

When the government lifts exchange controls, both the import restriction ω and the exchange rate gap τ_t disappear immediately. Exports returns to its undistorted steady state, and permanent consumption rises due to the elimination of import costs. However, the effect on money demand is ambiguous. On one hand, higher consumption benefits money demand. On the other, the removal of import restrictions raises the marginal cost of holding money which induces a substitution away from money and toward consumption. This trade-off can result in a temporary fall in real money demand, as the

induced substitution effect dominates.

3 Timing of the Abandonment of the Fixed Exchange Rate Regime

We now turn to the question of how exchange controls affect the timing of the abandonment of the fixed exchange rate regime. As outlined previously, the economy operates with a finite stock of international reserves, a fiscal authority that sets a constant real transfer to households, and a monetary authority that accommodates this policy through domestic credit expansion. While the environment of this economy is the same as that considered in first generation balance-of-payments models, the reason why reserves fall over time differs. In this case, reserves drop as a consequence of the worsening trade balance.

Under these conditions, the central bank will run out of reserves at a finite time T. In that moment, the government will decide to abandon the fixed exchange rate regime.

Assuming that $\varepsilon_t = 0$ for all $t \leq T$, the government's budget constraint is:

$$\bar{s} = rR_t + \pi_t m_t + \mu_t d_t \tag{17}$$

Starting from equation (7) and considering equation (17) we obtain:

$$\bar{s} = rR_0 + [\bar{s} - r(m_0 - m_T)]e^{-rT} \tag{18}$$

where m_0 is the real money demand prior to time T and m_T is the real money demand at time T.

To determine the timing of the crisis, we take the logarithm of both sides of equation (18) and obtain:

$$T = \frac{\log[\bar{s} - r(m_0 - m_T)]}{r} - \frac{\log(\bar{s} - rR_0)}{r} \tag{19}$$

Equation (19) shows that the timing of the crisis depends on the size of the initial stock of reserves R_0 and the magnitude of the money demand fall that

occurs when the peg collapses. A higher level of reserves allows the fixed exchange rate regime to last longer, while a larger fall in real money balances brings forward the moment of it's abandonment. Because both m_0 and m_T are influenced by the severity of import restrictions, ω, understanding how changes in ω affect money demand becomes central to the question of crisis timing. In what follows, we differentiate equation (19) with respect to ω to assess how tighter import restrictions alter the collapse date T.

I assume that the government will not remove the exchange controls after the collapse.

A change in ω affects T as follows:

$$\frac{\partial T}{\partial \omega} = \left[\frac{1}{\bar{s} - r(m_0 - m_T)}\right] \frac{\partial m_T}{\partial \omega} + \left\{\frac{r(d_T - d_0)}{(\bar{s} - rR_0)[\bar{s} - r(m_0 - m_T)]}\right\} \frac{\partial m_0}{\partial \omega} \quad (20)$$

Looking at equation (20), and considering that the terms that multiply the derivatives are both positive, we can easily see that the effect of an increase in ω on the timing of the crisis depends on how ω affects money demand.

The sign of equation (20) captures the ambiguous role of exchange controls in delaying a balance of payments crisis. If the substitution effect dominates the income effect so that money demand rises in response to tighter import restrictions, then the collapse is postponed. In this case, exchange controls succeed in buying time, though at the cost of lower consumption and higher distortions.

By contrast, if the income effect dominates, money demand falls, the parallel market premium widens and reserve losses accelerate. In this case, the policy is counterproductive: instead of stabilizing the system, it hastens its breakdown.

The effectiveness of tightening import restrictions to delay the crisis is therefore not assured. This ambiguity limits their reliability as a stabilization tool: a government unable to anticipate the dominant effect may implement a costly policy that ultimately backfires. In that sense, the case for exchange controls as a temporary measure is conditional, fragile, and potentially counterproductive.

3.1 Empirical analysis

To assess whether it is reasonable to expect that an increase in import restrictions might delay the onset of a balance of payments crisis, I consider a utility function commonly used in the literature. Specifically, following Uribe (2016) and Mosquera and Sturzenegger (2021),

$$U_t = \int_0^\infty \left(\frac{c_t^{1-1/\alpha} + A^{1/\alpha} m_t^{1-1/\alpha}}{1 - 1/\alpha} \right) e^{-\rho t} dt \tag{21}$$

where $-\alpha$ is the interest rate elasticity of money demand and A is a constant. Solving the consumer's problem yields:

$$m_t(c_t, i_t) = A c_t \left(\frac{1+\omega}{i_t} \right)^\alpha \tag{22}$$

From equation (15) we know that $\bar{c} = B/(1+\omega)$, where $B = r(x_0 + k_0) + r \int_0^\infty I_t e^{-rt} dt$.

If we accept that the present value of an individual's lifetime income varies little with changes in ω, we can ignore such variation. Therefore, the numerator of equation (15) does not change with modifications in the strictness of import restrictions.

Substituting the consumption path into (22) we get:

$$m_t = AB i_t^{-\alpha} (1+\omega)^{\alpha-1} \tag{23}$$

Taking the derivative of equation (23) with respect to ω yields:

$$\frac{\partial m_t}{\partial \omega} = AB i_t^{-\alpha} (\alpha - 1)(1+\omega)^{\alpha-2} \tag{24}$$

The sign of this derivative depends on α. If $\alpha > 1$, then the derivative is positive and vice-versa.

Therefore, knowing the value of the interest rate elasticity of money demand is crucial. For that reason, I estimate α using monthly data from Argentina for the period spanning November 2011 to March 2025, during which exchange controls were in effect for most of the time.

Money demand was estimated using the following model:[11]

$$\log(M_t/\mathcal{P}_t) = \beta_0 + \beta_1 \log[\mathbb{E}(\pi_{t+1})] + \beta_2 EC_t + u_t \tag{25}$$

where M_t represents the value of $M1$ monetary aggregate at time t, $\mathcal{P}_t$ is the CPI of period t, $\mathbb{E}(\pi_{t+1})$ is the expected inflation for period $t+1$ at the beginning of time t and EC_t is a dummy variable that takes the value one for the periods in which exchange controls were in place.[12]

I use inflation expectations, rather than the nominal interest rate, to proxy the opportunity cost of holding money. This is because nominal interest rates in Argentina were regulated for a substantial part of the sample period and, during those times, did not accurately reflect the true opportunity cost of holding money. Moreover, their potential endogeneity further limits their suitability for inclusion in the model. On the other hand, inflation expectations, as measured by the monthly survey conducted by Universidad Torcuato Di Tella, can be considered exogenous in a money demand model because they reflect beliefs formed based on information available at the time of the survey, rather than immediate reactions to contemporaneous changes in real money balances.

Data on M1 were obtained from the Central Bank of Argentina (BCRA). The consumer price index (CPI) series was constructed using the IPC-SL from the San Luis province statistical office up to July 2012; the simple average of IPC-CABA (from IDECBA) and IPC-SL from August 2012 to April 2016; the IPC-GBA from INDEC from May 2016 to November 2016; and the national CPI published by INDEC from December 2016 onward.

[11] Consistent with the general specification of money demand models reviewed by Sriram (2001), I also estimated (25) using the logarithm of the monthly real GDP, which I obtained by using the Denton-Cholette interpolation method and the monthly series of the EMAE index. The coefficient of the logarithm of the real GDP was not significantly different from zero. Furthermore, the estimates of β_1 were not sensitive to the inclusion of this variable in the regression.

In other estimations I included an interaction variable between the exchange controls dummy and the logarithm of expected inflation. The coefficient was not significantly different from zero.

[12] Since the official statistics for the CPI between 2007 and 2015 are unreliable, I computed the CPI following the methodology outlined by the Argentinian Central Bank.

Inflation expectations were sourced from the monthly survey conducted by Universidad Torcuato Di Tella.

Table 2 shows the results obtained.

Table 2: Results from the estimation of money demand

Dependent variable: $\log(M_t/\mathcal{P}_t)$	
Independent variable	**Model**
Inflation Expectations ($\log[\mathbb{E}(\pi_{t+1})]$)	-0.264^{***}
	(0.027)
Exchange Controls Dummy (EC)	0.073^{***}
	(0.016)
Intercept	5.918^{***}
	(0.102)
n	162

Robust standard errors are presented in parenthesis below the coefficients. The coefficients are statistically significant at 1% (***), 5% (**) or 10% (*). The series of $\log(M/P)$ and $\log[\mathbb{E}(\pi_{t+1})]$ are I(1) and cointegrated. Appendix B shows the unit root and cointegration test results.

The estimated elasticity of money demand with respect to the opportunity cost variable is -0.264 ($\alpha = 0.264$), a value much closer to -0.13, which corresponds to the estimate reported by Kiguel and Neumeyer (1995), than to the benchmark case of -1. Moreover, Benati, Lucas, Nicolini and Weber (2016) obtain that the median for the distribution of $-\alpha$ for Argentina between 1914 and 2009 is -0.280, which is also close to the estimate I obtained[13].

This finding suggests that a tightening of import restrictions may actually accelerate, rather than postpone, the onset of a balance-of-payments crisis. Accordingly, under exchange control regimes, tightening import restrictions is not advisable if the objective is to delay such crisis.

[13]Not only is the median of the interest rate elasticity distribution for Argentina close to my estimate, but among the 29 distributions analyzed, only one has its median and mode below -1 (i.e., implying $\alpha > 1$). Moreover, in only two of the 29 distributions is the fifth percentile of the interest rate elasticity below -1. This suggests that the conclusion of the interest rate elasticity being higher than -1 is relatively robust across time and countries, as Benati, Lucas, Nicolini, and Weber construct these distributions for 25 countries over periods ranging from 35 to 100 years.

IV Conclusions

The widespread use of exchange controls across countries calls for a careful examination of their macroeconomic implications and their effectiveness in achieving stabilization goals.

This thesis has shown that, under an imminent first-generation balance-of-payments crisis, exchange controls give rise to a widening gap between the parallel and the official exchange rate. This premium acts as an implicit and rising tax on legal exports, contributing to a continuous decline in their participation. At the same time, the import restrictions that typically accompany exchange controls generate additional distortions, raising the cost of imported inputs, reducing output, and lowering consumption. Import tightening also affects money demand, which may increase or decrease.

The analysis further demonstrates that the timing of the abandonment of the fixed exchange rate regime can be influenced by changes in import restrictions. The outcome hinges on the response of money demand: while, in theory, tighter restrictions could increase demand for money and temporarily extend the regime's life, the empirical evidence presented here suggests that money demand is more likely to fall, thereby bringing forward the collapse of the regime.

Overall, the findings indicate that exchange controls are highly distorting, particularly when implemented in the presence of inconsistent monetary and fiscal policies as the ones described here. The use of import restrictions as a tool to delay the crisis is, at best, unreliable and, more likely, counterproductive.

Ultimately, exchange controls are no substitute for addressing the underlying policy inconsistencies introduced by the monetary and fiscal authorities.

Appendix

A Automatic adjustment of the import restrictions

We now move beyond the simplified framework previously considered to explore broader macroeconomic implications of exchange controls. In particular, this section focuses on the decision-making process behind importing through unofficial channels in the presence of such controls.

Although import restrictions have been a central element throughout earlier sections, the novelty here lies in modeling these restrictions as endogenous to conditions in the export sector. Specifically, we consider a setting in which the government adjusts the degree of import restrictiveness in response to the amount of goods exported through official channels. When legal exports decline, the resulting shortfall in foreign currency reserves reduces the government's capacity to finance imports, leading to tighter import restrictions. To formalize this relationship, we extend the model by allowing the restrictiveness of the import regime, denoted ω_t, to depend negatively on the amount of legal exports: $\omega_t = \omega(Y^x_{o,t})$, with $\omega'(Y^x_{o,t}) < 0$. That is, higher legal exports allow for a less restrictive import regime. This formulation captures a natural feedback mechanism: compliance on the export side relaxes constraints on the import side.

The individual consumes both the smuggled and officially imported units and considers them perfect substitutes. Given that, we define the price level of this economy as $\mathcal{P}_t = \min(P^m_{s,t}, P^m_{o,t})$.

As will become clear later, the price level increases over time as a result of the widening exchange rate gap and the progressive tightening of import restrictions.

A.1 The Consumer

In this setup, the household's problem becomes:

$$\max U_t = \int_0^\infty u(c_{o,t} + c_{s,t}, m_t) e^{-\rho t} dt$$

subject to:

$$\dot{a}_t = r a_t + w_t + s'_t - i_t m_t - p^m_{o,t} c_{o,t} - p^m_{s,t} c_{s,t}$$

where $p^m_{o,t}$ denotes the relative price of officially imported units of the consumption good with respect to the domestic price level, and $p^m_{s,t}$ denotes the relative price of smuggled units of the imported good, also measured against the domestic price level.

A.2 The importer

On the import side, a representative importer decides how much to allocate between legal and illegal channels. The importer maximizes:

$$\max_{\sigma^m_{s,t}} \Pi^m_t = p^m_{s,t}\sigma^m_{s,t} + p^m_{o,t}\sigma^m_{o,t} - \left[1 + \omega\left(Y^x_{o,t}\right)\right]\sigma^m_{o,t} - \tau_t \sigma^m_{s,t} - V\left(\sigma^m_{s,t}\right) - F_s$$

subject to

$$\sigma^m_{o,t} + \sigma^m_{s,t} = 1; \quad 0 \leq \sigma^m_{s,t} \leq 1$$

$V\left(\sigma^m_{s,t}\right)$ is a cost the importer has to pay when he smuggles. The fixed cost F_s must be paid to engage in smuggling and $V''\left(\sigma^m_{s,t}\right) > 0$. The first order condition is:

$$p^m_{o,t} - \left[1 + \omega\left(Y^x_{o,t}\right)\right] - \lambda_1 = p^m_{s,t} - \tau_t - V'\left(\sigma^m_{s,t}\right) - \lambda_2$$

With complementary slackness conditions:

$$\lambda_1 \sigma^m_{o,t} = 0; \quad \lambda_2 \sigma^m_{s,t} = 0$$

If $0 < \sigma^m_{s,t} < 1$, both multipliers are zero, and the importer equalizes the

marginal benefit of legal and illegal imports:

$$p_{o,t}^{m} - \left[1 + \omega\left(\sigma_{o,t}^{x}\right)\right] = p_{s,t}^{m} - \tau_t - V'\left(\sigma_{s,t}^{m}\right)$$

If the fixed cost F_s is sufficiently large, the importer may choose not to smuggle at all ($\sigma_{s,t}^{m} = 0$), despite the fact that he may receive a higher marginal benefit. In such cases, the fixed cost prevents switching.
Overall, if the fixed cost is low enough, the importer will smuggle a positive share of goods. The optimal $\sigma_{s,t}^{m}$ is increasing in the wedge between legal and illegal import costs, which in turn depends on the evolution of τ_t, ω_t, and the cost function $V(\cdot)$. Since ω_t depends negatively on legal exports, any drop in export compliance raises ω_t, increasing the cost of legal imports and thus the incentive to smuggle.

A.3 Domestic Price Level

In equilibrium, all smuggled and officially imported units of the good must be absorbed through consumption. Since some level of smuggling always occurs—except when the fixed cost is sufficiently high—it follows that the representative consumer must be willing to consume both types of imports. This is only possible if their prices are equalized, given that the two are perfect substitutes.
This mechanism highlights a fundamental limitation of exchange controls as a tool for maintaining price stability. As the share of official exports declines, the government responds by tightening import restrictions. This reduction in import supply places upward pressure on domestic prices, contributing to an increase in the general price level. Since legal exports tend to decrease over time as the exchange rate gap widens, the tightening of import restrictions becomes a recurring feature of the system. As a result, domestic inflationary pressures are continuously reinforced.
This extension of the model illustrates that exchange controls eventually lose their effectiveness in containing domestic prices, even under a fixed exchange rate. In the end, monetary expansion translates into inflation.

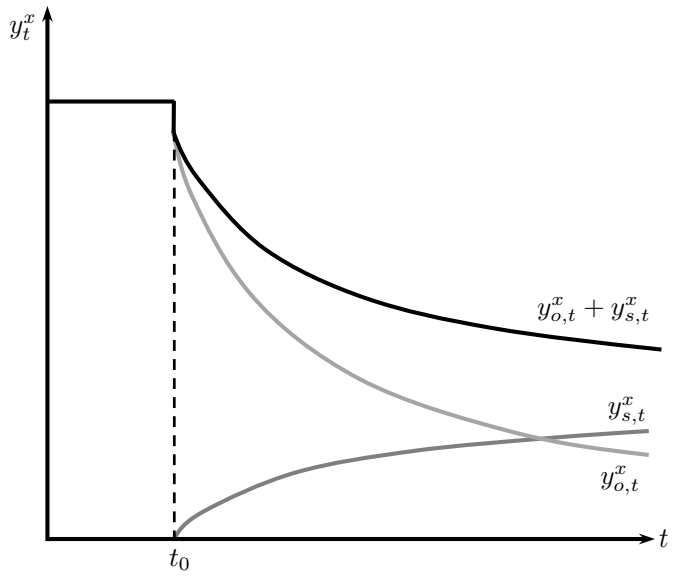

Figure 6: Trajectory of official, smuggled and total exports before and after exchange controls with automatic adjustment of import restrictions.

A.4 The Export Sector

The implications of a rising ω for the export sector can be inferred from equation (13). In particular, the persistent tightening of import restrictions and the expansion of the exchange rate gap raises the cost of capital per worker. As a result, firms progressively reduce their output over time, leading to a period-by-period decline in production. Consequently, official exports contract even further, which in turn prompts the imposition of even stricter import restrictions.

Figure 6 shows the behavior of total, official and smuggled exports in this scenario.

B Unit root and cointegration test results

B.1 Dickey-Fuller and ADF tests

Table 3 presents the results of Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests for the variables used in the money demand model. The

null hypothesis is that the series contains a unit root. $\log(M_t/P_t)$ and $\log \mathbb{E}(\pi_{t+1})$ are I(1).

Table 3: Unit Root Tests: DF and ADF Statistics at Different Lags

Variable	**DF**	**Lag 1**	**Lag 2**	**Lag 3**	**Lag 4**
$\log(M_t/P_t)$	-1.246	-1.139	-1.124	-0.983	-0.925
$\Delta \log(M_t/P_t)$	-13.424^{***}	-10.413^{***}	-8.061^{***}	-6.976^{***}	-6.059^{***}
$\log \mathbb{E}(\pi_{t+1})$	-1.736	-1.590	-1.628	-1.751	-1.609
$\Delta \log \mathbb{E}(\pi_{t+1})$	-13.885^{***}	-8.600^{***}	-6.925^{***}	-6.154^{***}	-5.571^{***}

*, **, *** denote 10 percent, 5 percent and 1 percent significance levels for the rejection of the null hypothesis.

B.2 Zivot-Andrews test

The Zivot-Andrews test accounts for the possibility of a structural break. The null hypothesis is the presence of a unit root with a one-time break in the intercept or trend.

Table 4: Zivot-Andrews Unit Root Test (Break in Intercept)

Variable	**Min t-statistic**	**Break Date**	**Obs.**	**5% Crit. Value**
$\log(M_t/P_t)$	-4.228	2023m1	136	-4.80
$\Delta \log(M_t/P_t)$	-13.569	2019m7	94	-4.80
$\log \mathbb{E}(\pi_{t+1})$	-2.756	2024m4	103	-4.80
$\Delta \log \mathbb{E}(\pi_{t+1})$	-13.240	2017m12	75	-4.80

Thus, $\log(M_t/P_t)$ and $\log \mathbb{E}(\pi_{t+1})$ are I(1).

B.3 Engle and Granger cointegration test

Table 5 shows the results for the Engle and Granger cointegration test. The null hypothesis is that no cointegration exists.

Table 5: Engle and Granger Cointegration Test

Residual Series	**ADF Statistic**
From $\log(M_t/P_t)$ on $\log \mathbb{E}(\pi_{t+1})$	-2.474^{**}

*, **, *** denote 10 percent, 5 percent and 1 percent significance levels for the rejection of the null hypothesis.

B.4 Johansen cointegration test

The results obtained with the Johansen cointegration test are shown in Table 6.

Table 6: Johansen Cointegration Test (Trace Statistic)

Rank	**Trace Statistic**	**5% Critical Value**
$r = 0$	16.48	15.41
$r \leq 1$	2.87	3.76

The test results shown in tables 5 and 6 suggest that $\log(M_t/P_t)$ and $\log \mathbb{E}(\pi_{t+1})$ are cointegrated, for which it makes sense to estimate a long run model for money demand.

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