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## MANAGING CURRENCY PEGS

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## **ABSTRACT**

### Managing Currency Pegs

The combination of a fixed exchange rate and downward nominal wage rigidity creates a real rigidity. In turn, this real rigidity makes the economy prone to involuntary unemployment during external crises. This paper presents a graphical analysis of alternative policy strategies aimed at mitigating this source of inefficiency. First- and second-best monetary and fiscal solutions are analyzed. Second-best solutions are prudential, whereas first-best solutions are not.

JEL Classification: E31, E62 and F41

Keywords: capital controls, currency pegs, downward nominal wage rigidity and pecuniary externality.

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When confronted with the current crisis in peripheral Europe, many specialists in emerging-market macroeconomics feel that it is déjà vu all over again. An implication of this feeling is that in order to understand the current situation in southern Europe, one should dust off the theories of exchange-rate crises that were motivated by the economic experience under fixed exchange rates in Latin America in the 1980s and 1990s.

We quarrel with this view. The models of the 1980s and 1990s were built around the premise that the fixed exchange-rate regime was unsustainable in the long run, primarily because of structural fiscal deficits. Celebrated examples of this body of work are Krugman's (1979) model of balance-of-payments crises and Calvo's (1986) temporariness hypothesis. In both of these models the emphasis is on the macroeconomic dynamics during the initial and terminal stages of finite-lived exchange-rate pegs.

In our view, the world is currently witnessing an entirely new breed of currency pegs. Unlike in the Latin American experience, in the European one countries joined a currency union as part of a much larger political and economic integration program with a group of countries that includes two of the largest and most developed economies in the globe, namely, Germany and France. As a consequence, for many of the emerging countries that are part of the eurozone, and for reasons that may exceed economic considerations, breaking away from the currency union may not be a viable option.

The policy challenges arising for this new generation of peggers call for at least three pieces of new theory. One piece is concerned with the characterization of economic fluctuations in emerging countries with fixed exchange rate regimes that are expected to be permanent.<sup>1</sup> In the presence of rigidities in nominal product or factor prices, these fluctuations are bound to be inefficient. For the combination of price rigidity and a fixed exchange rate amounts to two nominal rigidities, and, consequently, to a real rigidity. This real rigidity motivates the need for a second piece of new theory concerned with how to attain the first-best allocation when

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<sup>1</sup>There exists an earlier literature on permanent pegs for emerging countries known as the supply-side hypothesis of exchange-rate-based stabilization (see Roldós, 1995; Uribe, 1997; and Lahiri, 2001). However, the scope of this literature is limited to the initial dynamics of permanent currency pegs.

the central bank's hands are tied by a currency peg. Finally, because the policy instruments necessary to achieve the first-best allocation may not always be available to the policymaker, the third piece of theory needed is the study of second-best policy interventions that can be realistically implemented within a currency union.

In this paper, we summarize recent contributions of ours to these three theoretical issues (Schmitt-Grohé and Uribe, 2011 and 2012). For pedagogical reasons, here we employ a simple graphical approach.

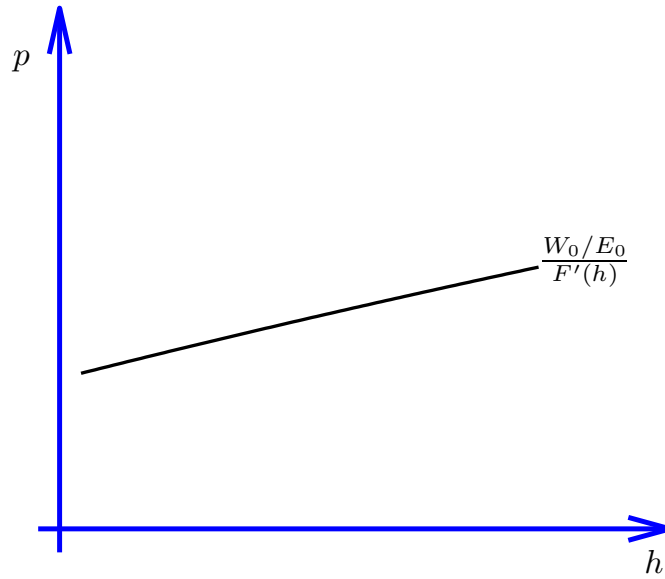
## 1 The Theoretical Framework

Consider a small open economy that produces tradable and nontradable goods. The supply of exportable goods, denoted  $TO T_t q_t$ , is exogenous and stochastic. It represents a source of aggregate fluctuations which can be interpreted as disturbances either to the terms of trade, denoted  $TO T_t$ , or to the physical abundance of the tradable endowment, denoted  $q_t$ .

Nontraded goods are produced using labor with the production function  $F(h_t)$ , where  $F$  is increasing and concave, and  $h_t$  denotes labor input. Let  $p_t \equiv P_t^N/P_t^T$  denote the relative price of nontradables in terms of tradables, where  $P_t^N$  and  $P_t^T$  denote, respectively, the domestic-currency prices of nontraded and traded goods. We assume that the law of one price holds for traded goods and that the foreign-currency price of traded goods is constant and normalized to unity. Then, we have that  $P_t^T = E_t$ , where  $E_t$  denotes the nominal exchange rate, defined as the domestic-currency price of foreign currency.

The labor cost faced by the firm, in terms of tradables, is given by  $w_t \equiv W_t/E_t$ , where  $W_t$  denotes the nominal wage rate. The firm is a price taker in product and factor markets. It chooses the amount of labor input to maximize profits, given by,  $p_t F(h_t) - w_t h_t$ , taking  $p_t$  and  $w_t$  as given. The first-order optimality condition of the firm's profit maximization problem is  $p_t = \frac{W_t/E_t}{F'(h_t)}$ . Figure 1 presents a graphical representation of this optimality condition in the space  $(h_t, p_t)$ . An increase in the relative price of nontradables raises the value of the

Figure 1: The Supply Schedule

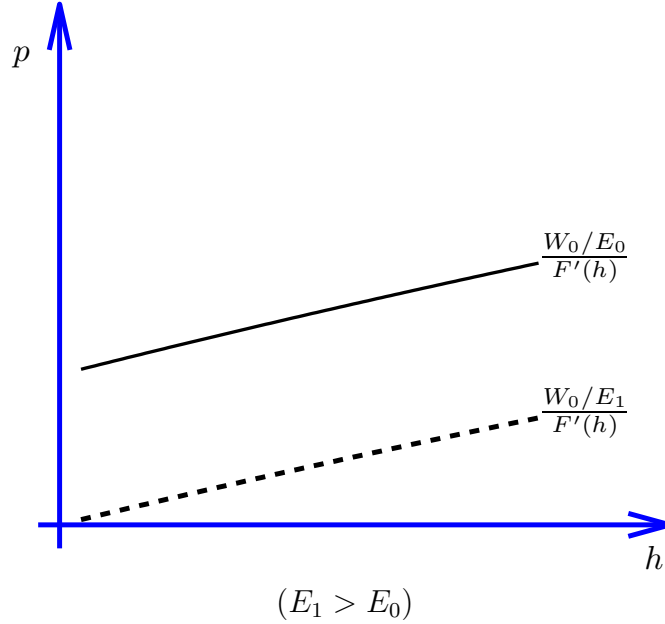


marginal product of labor, inducing firms to expand employment.

Suppose now that the government devalues the domestic currency by increasing the nominal exchange rate from  $E_0$  to  $E_1 > E_0$ . Suppose also that the nominal wage is held fixed at  $W_0$ . Then, firms experience a decline in the real cost of labor from  $W_0/E_0$  to  $W_0/E_1$ , which gives them an incentive to expand employment for any given level of the relative price  $p_t$ . Figure 2 illustrates this effect with a dashed line. In response to the devaluation, the supply schedule shifts down and to the right.

The desired aggregate absorption of nontradables, denoted  $c_t^N$ , can be derived from the household's optimization problem. It is summarized by the expression  $c_t^N = A(p_t; r_t, d_t, TOT_t q_t, \dots)$ , where  $r_t$  and  $d_t$  denote, respectively, the country's interest rate and external debt. The function  $A$  is decreasing in  $p_t$ , reflecting substitutability between tradable and nontradable goods in consumption. Any factor that changes the household's perceived permanent income or intertemporal price of consumption will in general affect the desired consumption of nontradables. In particular, the demand for nontradables is decreasing in  $r_t$  (assuming that the country is a net external debtor) and in  $d_t$  and increasing in  $TOT_t q_t$ . Combining this demand function with the market clearing condition in the nontraded sector, given by  $c_t^N = F(h_t)$ ,

Figure 2: A Devaluation Shifts The Supply Schedule Down and To the Right



we obtain the relationship  $h_t = D(p_t; r_t, d_t, TOT_t q_t, \dots)$ , where, like  $A$ , the function  $D$  is decreasing in  $p_t$ ,  $r_t$ , and  $d_t$ , and increasing in  $TOT_t q_t$ . We will refer to  $D$ , somewhat improperly, as the demand schedule. Figure 3 displays a downward sloping locus, indicating that, as the relative price of nontradables increases, households reduce their demand for this type of goods. In turn, the diminished absorption of nontradables requires fewer hours of work to be produced.

Suppose now that the country experiences an increase in the interest rate charged by foreign lenders from  $r_0$  to  $r_1 > r_0$ . Under our maintained assumption that the country is a net external debtor, the increase in the country premium causes the permanent income of households to fall. Because consumers feel poorer, they cut their demand for nontradables. As a result, the demand schedule shifts down and to the left as shown with a dashed line in figure 4.

The central friction in the present model is downward nominal wage rigidity. Specifically, we assume that  $W_t \geq \gamma W_{t-1}$ , where  $\gamma \geq 0$  is a parameter measuring the degree of downward wage rigidity. The higher is  $\gamma$ , the higher is the downward rigidity in nominal wages. In

Figure 3: The Demand Schedule

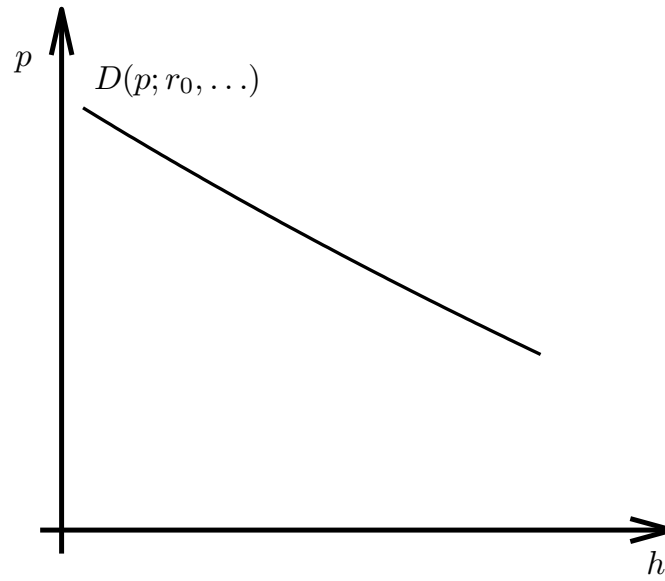


Figure 4: An Increase in the Interest Rate Shifts the Demand Schedule Down

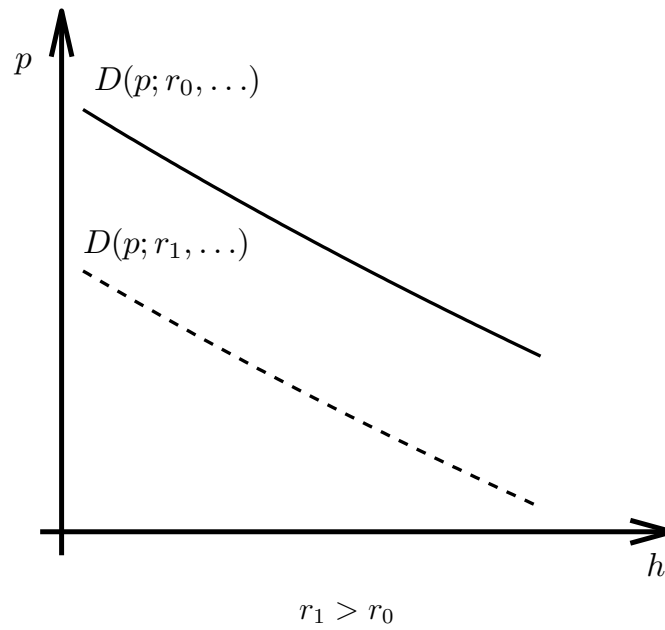
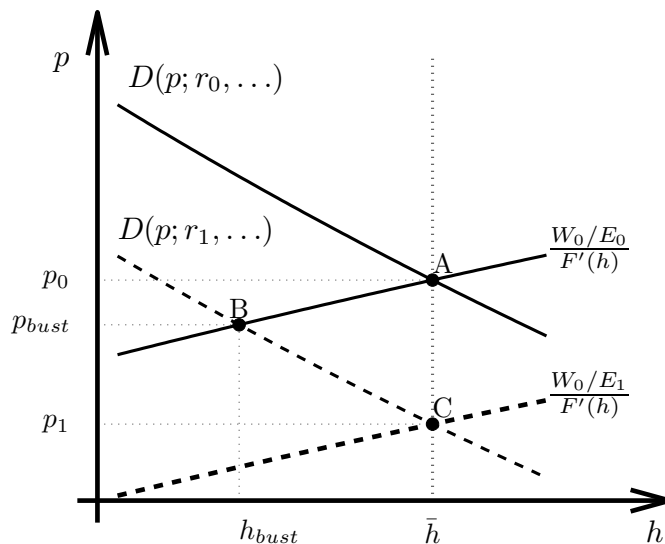




Figure 5: Adjustment Under Optimal Exchange-Rate Policy



Schmitt-Grohé and Uribe (2011), we present empirical evidence suggesting that nominal wages are downwardly rigid and that, for business-cycle analysis, a conservative value for  $\gamma$  is 0.99 when the length of a period is one quarter. We assume that workers supply  $\bar{h} > 0$  units of labor inelastically each period. However, worker will sometimes find that they cannot sell all of the  $\bar{h}$  hours and therefore in those periods, they will be involuntarily underemployed. Thus, we have that the constraint  $h_t \leq \bar{h}$  must hold at all times. Finally, the labor market closes with the slackness restriction  $(h_t - \bar{h})(W_t - \gamma W_{t-1}) = 0$ . This condition states that if in any given period there is underemployment ( $h_t < \bar{h}$ ), then the lower bound on nominal wages must bind. The slackness condition also states that if this constraint is not binding ( $W_t > \gamma W_{t-1}$ ), then the economy must be at full employment.

## 2 Pegs and Crisis Amplification

Having introduced the demand and supply schedules and described how the labor market closes, we can analyze the macroeconomic effects of negative external shocks. Figure 5 illustrates the adjustment process. The original position is at point A, where the supply and demand schedules intersect and the economy is operating at full employment ( $h_t = \bar{h}$ ). Now

suppose that the country interest rate increases from  $r_0$  to  $r_1 > r_0$ . As discussed above, this causes the demand schedule to shift down and to the left as shown by the downward sloping dashed line. Because the nominal exchange rate is pegged and because nominal wages are downwardly rigid (we are assuming for simplicity that  $\gamma = 1$ ), the supply schedule does not move. As a result, the new intersection occurs at point  $B$ . At this point, involuntary unemployment emerges in the magnitude  $\bar{h} - h_{bust}$ . At the level of the individual firm, the problem is that it experiences a fall in the price of the good it sells (from  $p_0$  to  $p_{bust}$ ), but no change in labor cost (the real wage remains constant at  $W_0/E_0$ ). To avoid losses, the firm must reduce employment, thereby cutting marginal costs (from  $(W_0/E_0)/F'(\bar{h})$  to  $(W_0/E_0)/F'(h_{bust})$ ).

The combination of a fixed exchange rate and downwardly rigid wages causes a spillover effect by which an external crisis, which could have been circumscribed to the traded sector, spreads its deleterious effects to the nontraded sector. A natural question is what policies can help the economy ameliorate these negative spillover effects. In our analysis, we take the downward rigidity in nominal wages as given. Of course, if the government could somehow implement policies that render the nominal wage fully flexible, then full employment would obtain at all times. The related empirical and theoretical literature, however, suggests the existence of important nonpolicy factors, such as morale, causing downward rigidity in nominal wages (see, for instance, Bewley, 1999).

### 3 First-Best Policy Interventions

We consider four policies that can achieve the Pareto optimal allocation. One is monetary in nature and the other three are fiscal.

### 3.1 Optimal Exchange-Rate Policy

In Schmitt-Grohé and Uribe (2011), we show that in the present model there exists an optimal exchange-rate policy that achieves the Pareto optimal allocation. This policy calls for a devaluation whenever the real wage consistent with full employment in any period  $t$  falls below  $\gamma W_{t-1}/E_{t-1}$ . Figure 5 illustrates how the optimal devaluation rate ensures full employment at all times. As explained earlier, in the absence of a devaluation, the increase in the interest rate pushes the economy from point  $A$ , where the labor market operates at full employment, to point  $B$ , where involuntary unemployment equals  $\bar{h} - h_{bust}$ . Suppose now that the government devalues the domestic currency from  $E_0$  to  $E_1 > E_0$ . The devaluation shifts the supply schedule down and to the right as shown by the dashed upward sloping line. If the size of devaluation is at least as large as the vertical fall in the demand schedule measured at  $h_t = \bar{h}$ , then full employment reemerges. The new equilibrium is at point  $C$ . At this point, firms voluntarily choose to continue to hire  $\bar{h}$  units of labor because although the price of the good they sell fell (from  $p_0$  to  $p_1$ ), their labor cost falls by exactly the same proportion (from  $W_0/E_0$  to  $W_0/E_1$ ).

### 3.2 Optimal Fiscal Policy

For emerging countries that are part of a currency union, such as those in the periphery of the eurozone, devaluations are not an option. In Schmitt-Grohé and Uribe (2011), we show that there is an array of fiscal policies that can bring about the Pareto optimal allocation without having to resort to movements in the nominal exchange rate. One such instrument is a labor subsidy. Suppose that the government decides to subsidize employment at the firm level at the proportional rate  $s_t^h$  per hour employed. In this case, the firm's optimality condition becomes  $p_t = (1 - s_t^h) \frac{W_t/E_t}{F'(h_t)}$ . This expression states that for a given relative price,  $p_t$ , and for a given real wage,  $W_t/E_t$ , the larger is the subsidy  $s_t^h$ , the lower is the marginal cost of labor perceived by the firm, and therefore the larger the amount of hours it is willing to hire.

Figure 6: Adjustment Under Optimal Labor Subsidy Policy

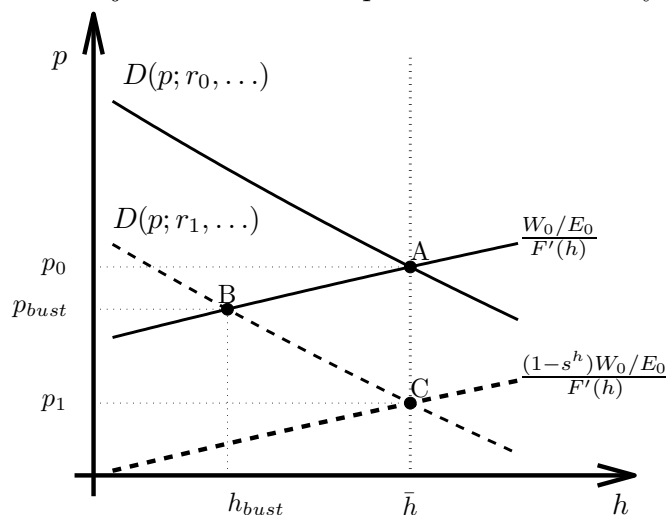
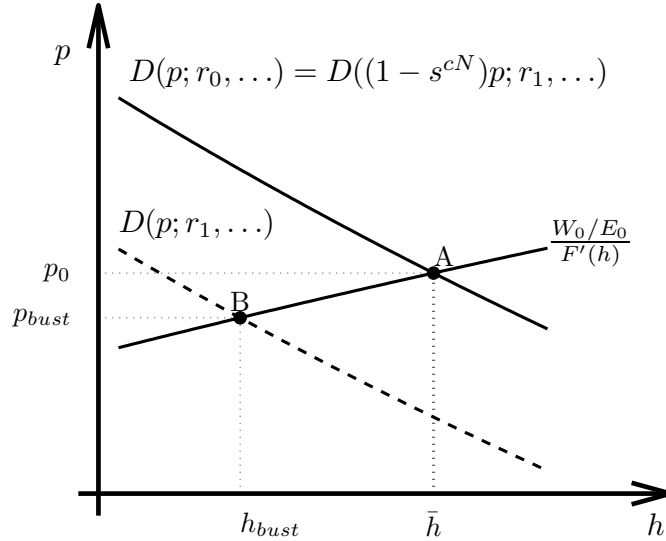


Figure 6 shows how labor subsidies can bring about the efficient allocation. Again, we consider a situation in which an external shock (in the example, an interest-rate increase from  $r_0$  to  $r_1$ ) brings the economy from an initial situation with full employment (point A) to one with involuntary unemployment in the amount  $\bar{h} - h_{bust}$  (point B). The labor subsidy causes the labor supply schedule to shift down and to the right, as shown by the dashed upward sloping line. The new intersection of the demand and supply schedules is at point C, where full employment is restored. We note that, unlike what happens under the optimal devaluation policy, the real wage does not fall during the crisis under the optimal labor subsidy. Specifically, the real wage received by the household remains constant at  $W_0/E_0$ . Once the negative external shock dissipates (i.e., once the interest rate falls back to  $r_0$ ), the fiscal authority can safely remove the subsidy, without compromising its full employment objective.

Another fiscal alternative to achieve an efficient allocation at all times is to subsidize sales in the nontraded sector. Let  $s_t^{yN}$  be a proportional subsidy on sales in the nontraded sector. An increase in the sales subsidy increases the marginal revenue of the firm. The profit-maximization condition of the firm becomes  $p_t = \frac{1}{1+s_t^{yN}} \frac{W_t/E_t}{F'(h_t)}$ . Like a wage subsidy, a sales subsidy shifts the supply schedule down and to the right. The graphical analysis is

Figure 7: Adjustment Under Optimal Taxation of Nontradable Consumption



therefore qualitatively identical to that used to explain the workings of the optimal wage subsidy shown in figure 6.

A third fiscal instrument that can be used to ensure full employment at all times in a pegging economy with downward nominal wage rigidity is a proportional subsidy to the consumption of nontradables. Specifically, assume that the after-subsidy price of nontradable goods faced by consumers is  $(1 - s_t^{cN})p_t$ . The nontraded-consumption subsidy makes nontradables less expensive relative to tradables. It can therefore be used by the government during a crisis to facilitate an expenditure switch toward nontraded consumption and away from tradable consumption. With nontraded-consumption taxes, the demand schedule is given by  $D(p_t(1 - s_t^{cN}); r_t, \dots)$ . Figure 7 illustrates how the consumption subsidy can be optimally used to ensure the efficient functioning of the labor market. Again, the increase in the interest rate from  $r_0$  to  $r_1$  shifts the demand schedule down and to the left. As discussed before, in the absence of any intervention, our pegging economy would be stuck at the inefficient point  $B$ . The introduction of the nontraded-consumption subsidy shifts the demand schedule back up and to the right. If the magnitude of the subsidy is chosen appropriately, the demand schedule will cross the supply schedule exactly at point  $A$ , where

the labor market returns to full employment.

A criticism that can be made against all three of the fiscal alternatives considered here is that the implied tax policies inherit the stochastic properties of the underlying sources of uncertainty (e.g.,  $r_t$ ,  $q_tTOT_t$ , etc.). This means that tax rates must change at business-cycle frequencies. To the extent that changes to the tax code are subject to legislative approval, the long and uncertain lags involved in this process might render the implementation of the optimal tax policy impossible.

## 4 Second-Best Policy Intervention

We now consider capital controls as a way to mitigate the inefficient adjustment of economies with fixed exchange rates and downward nominal wage rigidity. The present analysis draws from Schmitt-Grohé and Uribe (2012). Suppose that the government imposes a tax  $\tau_t^d$  on external borrowing. Negative values of  $\tau_t^d$  correspond to a subsidy to external borrowing. This type of capital control raises the effective interest rate on external debt from  $r_t$  to  $r_t + \tau_t^d$ . The demand schedule then becomes  $D(p_t; r_t + \tau_t^d, \dots)$ . In principle, the government could use capital controls to fully offset any changes in the interest rate with changes in  $\tau_t^d$ . In this case, the effective interest would be constant, and the demand schedule would not shift in response to disturbances in  $r_t$ . Consequently, full employment in the nontraded sector would be preserved at all times. Such a policy, however, would not be optimal. For the effective interest rate  $r_t + \tau_t^d$  governs the intertemporal price of tradable consumption. Thus, the capital control rate  $\tau_t^d$  represents a wedge in the relative price of future and present consumption that distorts the intertemporal allocation of expenditure. In determining the optimal value of  $\tau_t^d$ , the benevolent government, therefore, faces a trade off between an intertemporal distortion in consumption and a static distortion in the labor market. As a result of this tradeoff, the tax rate  $\tau_t^d$  will adjust over the business cycle but will not fully stabilize the effective country interest rate.

Figure 8: Optimal Capital Controls and an Interest Rate Increase

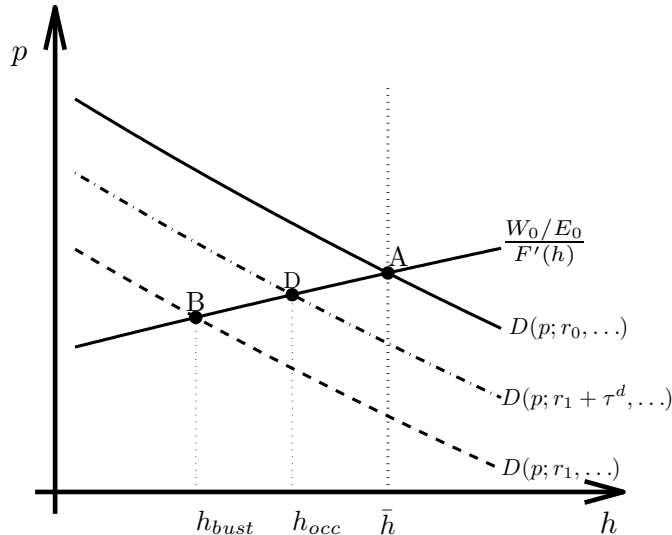
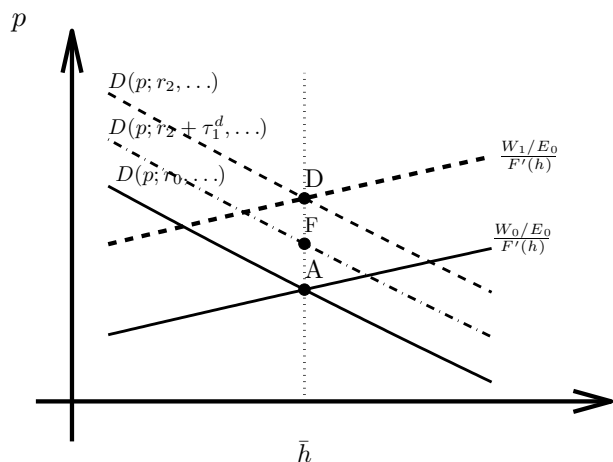


Figure 8 illustrates the role of optimal capital controls. As in the previous policy experiments, the starting point is  $A$ , where the economy enjoys full employment. Under free capital mobility, an increase in the country interest rate from  $r_0$  to  $r_1$  shifts the demand schedule down and to the left and brings the economy to point  $B$ , where the unemployment rate is  $\bar{h} - h_{bust}$ . Suppose now that the fiscal authority subsidizes external borrowing by setting  $\tau_t^d$  at a negative value. This policy move incentivates external borrowing and aggregate absorption, causing the demand schedule to shift up and to the right as shown by the dashed-dotted line. The new intersection is at point  $D$ . At this point, the level of employment is higher than at point  $B$  (corresponding to the outcome associated with free capital mobility), but still less than at point  $A$ , indicating that some unemployment remains even under optimal capital controls.

In Schmitt-Grohé and Uribe (2012), we stress the fact that the optimal capital control policy is prudential. That is, unlike what happens under the other fiscal and monetary instruments considered earlier in this paper, under the optimal capital control policy the government acts preemptively during booms to curb aggregate spending via capital controls. Figure 9 illustrates the use of optimal capital controls during booms. In the graph, a fall

Figure 9: Optimal Capital Controls and an Interest Rate Decrease

(b) An decrease in  $r$  from  $r_0$  to  $r_2$



in the country interest rate from  $r_0$  to  $r_2 < r_0$  shifts the demand schedule up and to the right, as shown with a dashed line. Under free capital mobility, the new equilibrium is at point  $D$ , where the economy is at full employment. As a result of the boom, the nominal wage increases from  $W_0$  to  $W_1$ . This wage adjustment materializes frictionlessly, because nominal wages are assumed to be upwardly flexible. The reason why the government has an incentive to put sand in the wheels of expenditure in this phase of the cycle is that when the shock dissipates and aggregate demand falls back to its normal level, the required fall in real wages will not occur quickly enough because of the downward rigidity of nominal wages and the fixity of the nominal exchange rate. The government therefore imposes capital controls ( $\tau_1^d > 0$ ), which cause the demand schedule to shift down and to the left, as shown with a dashed-dotted line. The new intersection is point  $F$ , where the unemployment rate is zero, the nominal wage is lower than at point  $D$ , but higher than at point  $A$ , and the aggregate absorption of tradables is smaller than under free capital mobility.

While achieving only a second-best allocation, capital controls have the advantage over income or consumption taxes that in many countries they can be much more swiftly implemented.



## 5 Conclusion

An important policy issue is how to finance the various subsidies discussed in this and the previous section. In Schmitt-Grohé and Uribe (2011, 2012), we show that they can be financed in a nondistorting fashion with a proportional tax on labor income of households. The reason why labor income taxes are nondistorting in a crisis is that in these circumstances households find themselves off their supply schedule (i.e., they are willing to work longer hours at the going wage than they are actually working).

To conclude, we would like to stress that because the central friction in the present model is nominal (downward nominal wage rigidity), the natural instrument to correct it is monetary policy. All of the fiscal alternatives discussed above (including capital controls) are likely to be significantly harder to implement in practice for the simple reason that the monetary authority has the capacity to intervene at a speed far exceeding that at which the fiscal authority can alter the tax code or impose capital controls. Finally, while an individual country in the periphery of the eurozone is powerless when it comes to changing monetary policy, the union's monetary authority could help the unemployment problem of ailing members by engineering an increase in the eurozone's overall rate of inflation.

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