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Price Controls in a Simple Competitive Monetary Model of a Small Open Economy*

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Abstract

We construct a simple monetary general equilibrium model of a small open economy to examine the effects of three price intervention policies. We find that, under fixed exchange rates, a small intervention on the producer's price of the domestically produced non-traded good or a small revaluation of the exchange rate improves current welfare but deteriorates the trade balance. We apply the theory of economic policy to show that, if the government can impose more than one policy instrument, it is possible to improve national welfare without affecting the trade balance.

I. Introduction

Price regulation has been common in many countries. Examples are price ceilings on many necessity and utility goods, minimum wage rates, and

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exchange rate fixing. It is well known that in countries such as China, Cuba, Brazil, and Russia, prices in many major sectors of the economy are or have been under strict government controls, but even in Western capitalist countries, price control is a widely used policy.

Because price control is so widespread and because of the importance of prices as signals of resource scarcity in the market mechanism, there have been many different economic theories of the causes and effects of price control. Yet there is no universally accepted theory of price control. Problems and issues vary so much that different analysis are needed in different circumstances. From time to time, papers on the causes and effects of regulating prices emerge in the literature.

Three recent papers on price controls that appear in the literature are Helpman [1988], Kemp and Long [1990], and Wong [1992].[1] While Helpman [1988] discusses the effects of price control and market structure in chronic inflationary economies, Kemp and Long [1990] and Wong [1992] examine the effects of relaxing existing restrictions on price levels in some Asian and Eastern European countries. While these three papers have obtained many interesting results, there are still many questions to be answered.[2]

First, the models in Helpman [1988] and Wong [1992] are barter. Money demand is not explicitly specified, and money does not play any active role in the models. This is not satisfactory if we want to address issues related to inflation.[3] Second, Kemp and Long [1990] do include a demand for money,

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1. There is a related literature that examines the effects of price control policies in the British and the US economy in the 1960s and early 1970s. See *e.g.* Blackaby [1978] and Branson [1991] respectively for details of those policies. An interesting extension of the issue of price controls pertains to the literature of general equilibrium with incomplete markets, as in Cornes [1989].
2. Wong [1992] follows the development economics tradition of analyzing price controls from the perspective of its induced rent seeking behavior. Diamond [1978] is an early contribution on issues of income distribution from the perspective of tax policy incidence, in a related model. Nguyen and Whalley [1990] follow an alternative route of endogenizing the transactions costs associated with fixed prices. Finally, Levy [1991] adopts a two-sector model of the private and public activities to examine the quantitative effects of price controls.
3. Feenstra [1985] is a related trade model in a monetary framework which deals with trade controls, among other issues.

but they only consider a closed economy and do not examine how a price control may affect the trade balance of the economy. Helpman [1988], on the other hand, does provide an explicit examination of the effects of price control on the trade balance, but in order to obtain trade balance effects he assumes that aggregate income is given exogenously. This assumption is arbitrary. Third, none of these papers analyzes the effects of price control on the nominal exchange rate. We fill these gaps in the literature, most importantly with respect to the nominal exchange rate which is an important price in an open economy and controlling it is a common practice in many countries.

In this paper, we construct a simple general equilibrium framework of a small, open economy to examine the effects of three price intervention policies: (i) controlling the price of the domestic good; (ii) controlling the exchange rate; and (iii) controlling the money supply. Special attention is paid to the effects of these policies on current national welfare and the trade balance. While current national welfare represents what welfare the economy enjoys in the present period, the trade balance can be regarded as an index of the future welfare of the economy when an intertemporal budget constraint has to be satisfied.

We find that, in the case of fixed exchange rates, a small intervention on the producer's price of the domestically produced non-traded good or a small revaluation of the exchange rate improves current welfare but deteriorates the trade balance. The reason for this apparent counterintuitive result is the fact that the fixed exchange rate introduces a friction that can be alleviated by the price control, as in the well known theory of the second best, see for example Lloyd [1974]. With fixed exchange rates, the domestic price of the goods that are priced abroad cannot adjust to underlying disturbances. This implies certain deviations of real prices from their respective marginal products which can be damped by the price intervention policies.

The effects of price control on welfare and trade balance simultaneously is disturbing. Our results show that there is a trade-off between welfare and trade balance, and since the trade balance can be regarded as an index of future welfare, we establish a trade-off between current and future consumption. Therefore, in the second half of the paper we extend our model to cases in which the government wants to have a tight control over the trade

balance while at the same time price control is used to maximize welfare. To do this, we take the non-economic-objective approach which has been commonly used in the trade literature, see *e.g.* Bhagwati and Srinivasan [1969]. In other words, we choose an exogenous trade balance as a non-economic objective, and let the government choose the appropriate prices to maximize national welfare.

However, it is well known that if the government chooses just one price (say one instrument), the maximum welfare that the economy can achieve under trade balance constraint is generally less than the constraint-free maximum welfare level. To obtain the latter level of welfare, we apply Tinbergen's [1952] theory of economic policy intervention and consider the control of two prices at the same time. This allows the government to achieve the maximum welfare without violating the trade-balance constraint. Different pairs of policy instruments are analyzed. The results are particularly useful for those countries which are under pressure to maintain significant levels of residents' welfare without letting the trade balance go beyond certain bounds.

The paper is organized as follows. In Section II, we present the general equilibrium framework. Section III considers a fixed exchange rate regime and analyzes the effects of different policies which are either imposed separately, or jointly to maintain a zero trade balance. This section also derives the effects of technology progress and foreign price disturbances on the equilibrium prices and quantities. In Section IV, a flexible exchange rate regime is considered; Section V examines the case in which the government controls both the consumer's and the producer's price of the domestic non-traded good and Section VI concludes.

II. General Framework

Consider an economy which takes foreign prices as given. This economy is inhabited by a large number of identical agents, each maximizing utility and supplying a fixed amount of labor. Production consists of a large number of identical firms, each maximizing profits competitively. There is a government which supplies a fixed amount of money, used by consumers for cash transactions, and chooses a specific exchange rate policy. There are

three goods labeled good M, good X, and good N. The economy produces goods X and N, with good X being exported but not consumed domestically and good N being a non-traded good produced and consumed domestically. Good M is imported from the rest of the world and consumed by domestic residents. Denote the domestic price of goods, M, X, and N by P_m, P_x, and P_n, respectively, and denote the foreign prices of M, and X by P_m^* and P_x^* respectively. By the assumption of a small open economy, P_m^* and P_x^* are taken as given. Denote the exchange rate, or the domestic price of foreign currency, by E. In equilibrium, we have $P_m = EP_m^*$ and $P_x = EP_x^*$. In turn, the economy faces a fixed level of external terms of trade, $(P_m/P_x)=(P_m^*/P_x^*)$.

(i) *Technology* – There is one domestic factor of production, labor, of which the inelastic aggregate supply is denoted by L. The technologies of the economy are characterized by two sectoral production functions

$$Y_x^s = A_x f_x(l_x) \tag{1a}$$

$$Y_n^s = A_n f_n(l_n) \tag{1b}$$

where Y_i^s, $i = x, n$; are the domestic output supplied in the traded and non-traded sectors respectively; A_i, $i = x, n$; are Hicks' technological shift parameters; l_i, $i = x, n$; are the labor input in the specific sector satisfying $l_x + l_n = L$; and the functions $f_i(\cdot)$, $i = x, n$; are increasing, twice differentiable, and concave.

(ii) *Preferences* – the representative agent derives utility from the consumption of the non-traded good, denoted x_n, and the imported good, denoted x_m. The utility function takes the general form $U(x_n, x_m)$, where the function $U(\cdot, \cdot)$ is increasing, twice differentiable, strictly quasi-concave and assumed homothetic. Considering the bundle which minimizes expenditures necessary to obtain some utility level at given prices, one obtains the corresponding expenditure function denoted by $e(P_n, P_m, U)$ where P_i, $i = n, m$; are the common prices faced by the consumer. The function $e(\cdot, \cdot, \cdot)$ is increasing, twice differentiable, homogeneous of degree one and concave in prices.

(iii) *Government* – the government supplies a fixed stock of nominal money, M^s, and redistributes, in a lump-sum fashion, any gains or losses, in terms of proceedings from consumer's or producer's market price interven-

tions, to consumers. The exchange rate policy consists of either a fixed exchange rate or a flexible exchange rate to be defined below.

(iv) *Transactions Demand for Money* – transactions are carried out on a cash basis implying the following transactions demand for money

$$M^d = \phi e(P_n, P_m, U) \tag{2}$$

where $0 < \phi \leq 1$ is a constant parameter which may be interpreted as the inverse of the velocity of circulation functioning as the link between stocks and flows. Equation (2) may be rationalized as either a quantity theory of money equation or a binding cash-in-advance constraint.[4]

A. Competitive Equilibrium

The competitive equilibrium of this economy consists of a set of relationships where firms maximize profits, consumers maximize utility, labor and goods markets clear, and an exchange rate policy is defined. In general, the following set of conditions represent an equilibrium:

$$P_x A_x f'_x (l_x) = w \tag{3a}$$

$$q A_n f'_n (l_n) = w \tag{3b}$$

$$l_x + l_n = L \tag{3c}$$

$$e_n(P_n, P_m, U) = A_n f_n (l_n) \tag{3d}$$

$$T = P_x A_x f_x (l_x) - P_m e_m(P_n, P_m, U) \tag{3e}$$

$$qA_n f_n(l_n) + P_x A_x f_x(l_x) + (P_n - q) e_n(P_n, P_m, U) + M_s = e(P_n, P_m, U) + M^d \tag{3f}$$

where q is, for example, a producer's controlled commodity price which

4. This may be seen by considering the consistency condition that money income is sufficient to achieve the given utility level, or

$$Q = \phi e(P_n, P_m, U) \tag{$*$}$$

where Q is nominal income. Now, consider a quantity theory of money equation as

$$M^d V = Q \tag{$**$}$$

where V is the velocity of circulation. Equations ($*$) and ($**$) imply equation (2) with $\phi = 1/V$. Then, $1/\phi e_u$ is the marginal utility of money balances where $e_u = \partial e/\partial U$. The limiting case of $\phi \to 0$ may be interpreted as a barter economy, as in Helpman [1988].

may diverge from P_n. Equations (3a)–(3b) are the firms' profit maximizing conditions while (3c) is the labor market constraint. Equation (3d) is the equilibrium condition for the market for domestically produced goods, where $e_i = (\partial e/\partial P_i)$, $i = n, m$; are the compensated or Hicksian demands for good i satisfying homogeneity of degree zero in prices. Equation (3e) describes the trade balance given by the total exports minus total imports. Finally, equation (3f) denotes the aggregate budget constraint of this economy where the left-hand-side (LHS) is total income and the right-hand-side (RHS) is total demand. Also, note that the commodity tax revenue given by $(P_n - q)e_n(P_n, P_m, U)$, if any, is assumed to be distributed to the consumers in a lump-sum fashion.[5]

The exchange rate policy is spelled out in the following manner. A policy of fixed exchange rate, E_o, solves the system (3) for the endogenous variables w, l_x, l_n, P_n, T, and U given foreign prices P_m^*, P_x^*, the technological shifts A_x, A_n, the money stock M_o^s, and the fixed exchange rate E_o.[6] A policy of flexible exchange rate is defined as a solution for the system (3) for the endogenous variables w, l_x, l_n, P_n, U, and E given a zero trade balance, $T = 0$, foreign prices P_m^*, P_x^*, the technological shifts A_x, A_n, and the money stock M_o^s.[7]

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5. Note that equations (3d)-(3f) imply

$$T = \phi e(P_n, P_m, U) - M^s = M^d - M^s.$$

In this model, the equilibrium relationship between imports and exports means that a trade surplus (deficit) may occur according to the willingness of domestic residents to demand more (less) cash than the inelastic government supply, for instance $T > 0$ indicates a trade surplus. T is in fact consistent with the monetary approach to the balance of payments. Note that, without loss of generality, we chose q to be the producer's price and P_n the consumer's price of the non-traded good. With the appropriate interpretation, it does not matter whether the government controls directly the consumer's or the producer's price, see Section III. D below.

6. Note that, in this model, a fixed exchange rate and a fixed money supply are not mutually exclusive. This is because an endogenous trade balance allows excess demand (or supply) in the money market. If the restriction $T = 0$ is added, then the money supply or the commodity price control must become endogenous to sustain a fixed exchange rate.

7. The solutions are also functions of the total labor supply, L, which is assumed constant throughout the paper.

III. Market Price Intervention Under Fixed Exchange Rates

The focus of this paper is to examine the trade balance and welfare implications of market price interventions. The trade balance implications will be related to the use of policy instruments in order to attain specific objectives and to some form of exchange rate regime, say perfectly flexible exchange rates with a fixed money supply. The welfare implications, in turn, require the investigation of the Pareto optimality of the prevailing economic system, in the sense that if the system is already characterized as a Pareto optimal equilibrium, then any market price intervention will lead to a Pareto inferior outcome. However, if the prevailing system presents some distortion that drives it away from the Pareto optimal equilibrium, then market price intervention may or may not be welfare improving. While the former case is closely related to Tinbergen's [1952] theory of economic policy, the latter case is a direct consequence of the theory of the second best, see *e.g.* Lloyd [1974].[8]

In this section, we examine the case of fixed exchange rates which are controlled by the government. We begin with an initial equilibrium of the economy in which there is no price control so that the consumer's price of the non-traded good is the same as the producer's price, $q = P_n$. Furthermore, the initial exchange rate, E_o, is given at a level so that the resulting trade balance is zero, $T = 0$.

A. Comparative Statics

In this subsection, we examine the effects of the following policies: (i) commodity price control, say a change in the producer's price of the non-traded good q while the exchange rate and the money supply are fixed; (ii) exchange rate devaluation, say a change in the exchange rate E while the money supply is fixed and q is free to adjust such that no divergence between the producer's price of the non-traded good and the consumer's price exists; (iii) monetary policy, say a change in the money stock M while

8. The reader is also referred to Dixit [1985] for a related analysis in the case of tax policy in open economies. Note that the problem studied in this paper may be reinterpreted in terms of producer's, consumer's, or both tax/subsidies.

the exchange rate is fixed at E_o and q is free to adjust.

(i) *Commodity price control* – The effects of an increase in the producer's price of the non-traded good q are reported in Table 1. The first result is that generally the welfare effect of the price control is non-zero, $\partial U/\partial q \neq 0$. More interesting is that when evaluated at an initial equilibrium at which $q=P_n$, $\partial U/\partial q > 0$.[9] This seems to suggest that a small increase in the producer's price of the non-traded good is welfare enhancing.[10] Furthermore, the expression of $\partial U/\partial q$ implies that the welfare can be maximized by choosing the optimal commodity tax rate given by

$$q - P_n = -\phi\,(e_n/e_{nn}) > 0. \tag{4}$$

In words, the wedge between the producer's commodity price and the outcome of the new consumer's price should be positive and equal to the ratio of the demand for non-traded goods and its price elasticity times the inverse of the monetary velocity.[11]

However, the above welfare effect of the commodity price control should be interpreted with caution, because there is a simultaneous effect on the trade balance also shown in Table 1. In general, this effect on the trade balance is ambiguous. There are two forces arising in the effect on the trade balance. First, there is the effect reflecting the gap between the control and the ultimate resulting market price which induces the necessity of additional cash for expenditures. The second effect is the mirror of the first on the utility achieved at that new level of expenditures. The two effects go in

9. Notice that $e_{ij} = (\partial^2 e/\partial P_i P_j)$, $i = n, m$; $j = n, m$; are the second partial derivatives of the expenditure function with respect to prices. Here, the own price effect, *i.e.* $i = j$, is negative and symmetric while the effect with respect to the other good is negative because of the assumed linear homogeneity of the expenditure function, *i.e.* $e_{mn} = e_{nm} > 0$ implying that $z_2 > 0$. In turn, the non-traded good and the imported good are substitutes.

10. The drawback of our results is that our model is static. However, this may be moderated by the results of Keen [1990], who shows that intertemporal welfare effects reflecting intertemporal substitution are basically second order effects. One should recognize though that Keen's results are based on the extreme assumption of separability of preferences.

11. Note that if $\phi \to 0$ as in the barter economy of Helpman [1988] then $q=P_n$, and the optimal price control equals the market price, *i.e.* the optimal commodity tax rate is zero.

opposite directions because, from the consumer's point of view, a higher producer's price control represents a lower price for consumption and therefore a larger quantity consumed enabling him to attain a higher level of utility.

At an initial equilibrium when $q = P_n$, and if the non-traded good and the imported good are substitutes, then $\partial T/\partial q < 0$. This means that an initial increase in U due to the commodity price control is accompanied by a trade deficit. In special cases in which the costs of trade deficits are sufficiently low, U is indeed a good measure of welfare for the small open economy. If, however, current trade deficits have to be covered in the future by trade surpluses, it implies a drop in future consumption. Thus U may not be a good measure of welfare for the small open economy.[12]

The effect of the commodity price control on the consumer's price, $(\partial P_n/\partial q)$, is negative as may be seen from Table 1. Intuitively, the price control introduces a wedge between the consumer and the producer price, and the larger the distance of the control from the equilibrium, the larger the gap between the two prices. Moreover, it is required that the producer's price be put above the undistorted equilibrium implying that the consumer's price will be lower than the undistorted equilibrium. In this case, the consumer is able to consume a larger quantity. The effect of the producer's price control on the other endogenous variables may also be assessed from Table 1. The

Table 1

Effects of Price Controls Under Fixed Exchange Rates (∂q)

$$\partial U/\partial q = z_1 A_n f_n' [e_{nn}(P_n - q) - \phi e_n]/z_2$$

$$\partial P_n/\partial q = z_1 A_n f_n' [\phi e_u + q e_{nu} + P_m e_{mu}]/z_2 < 0$$

$$\partial l_x/\partial q = -\partial l_n/\partial_q = z_1 < 0$$

$$\partial w/\partial q = P_x A_x f_x'' z_1 > 0$$

$$\partial T/\partial q = \partial M^d/\partial q = \phi z_1 A_n f_n' [P_m e_{mu} e_n + q e_{nu} e_n + e_u e_{nn} (P_n - q)]/z_2.$$

where

$$z_1 = [A_n f_n'/(P_x A_x f_x'' + q A_n f_n'')] < 0,$$

$$z_2 = \{P_m [e_{nu} e_{mn} - e_{nn} e_{mu}] + \phi [e_{nu} e_n - e_{nn} e_u]\}.$$

12. See, for example, Dixit and Norman [1980], Chapter 7, page 208, for a similar result.

negative effect on l_x and the positive effect on l_n reflect the fixed total labor supply and the fact that the amount of labor employed in the non-traded sector will be directly related to the producer's price control in that sector. This leads to a contrary effect on the other (export) sector. Labor mobility between the two sectors equalizes the nominal wage, and the overall effect of the price control on the nominal wage is positive meaning that a higher price control increases the nominal wage in both sectors. However, with the traded good sector being price taker, an increase in the nominal wage leads to a fall in the amount of labor employed in that sector.

(ii) *Exchange rate devaluation* – The effects of changes in the exchange rate are reported in Table 2. The effect on national welfare is negative indicating that a depreciation leads to lower national welfare or alternatively lower domestic consumption.[13] The effect on the consumer's price level, under the assumption of $z_7 > 0$, is positive and leads to the standard result that a depreciation raises the consumer's price level through its effect on the domestic price of imports. Following that, it is shown that an exchange

Table 2
Effects of Devaluation (∂E_o)

$$\partial U/\partial E_o = (1/z_4)\ [e_{nn}\, z_7 - z_6\, z_8]$$
$$\partial P_n/\partial E_o = (1/z_4)\ [z_5\, z_6 - e_{nu}\, z_7]$$
$$\partial l_x/\partial E_o = -\,\partial l_n/\partial E_o = z_3 > 0$$
$$\partial w/\partial E_o = -\,q\, f''_n\, z_3 < 0$$
$$\partial T/\partial E_o = \partial M^d/\partial E_o = \phi\ \{e_m + (1/z_4)\ [e_n(z_5\, z_6 - e_{nu}\, z_7) + e_u(e_{nn}\, z_7 - z_8\, z_6)]\}$$

where

$$z_3 = -\ [P^*_x A_x f'_x/(P_x A_x f''_x + q\, A_n f''_n)] > 0,$$
$$z_4 = e_{nn}\, z_5 - e_{nu}\, z_8,$$
$$z_5 = (P_m e_{mu} + \phi e_u),$$
$$z_6 = -(z_3 f'_n A_n + e_{nm}),$$
$$z_7 = [P^*_x A_x f_x + P_x A_x f'_x\, z_3 - P_m\, e_{mm} - e_m\ (\phi + P^*_m)],$$
$$z_8 = (P_m e_{mn} + \phi e_n).$$

13. This result is qualified by the assumption of substitutability between the non-traded and imported good, and $e_{nn} z_7 < z_6 z_8$ and noting that $z_4 > 0$.

rate depreciation leads to more activity in the traded sector while the contrary is observed in the non-traded sector. The overall effect on the nominal wage, in turn, is negative. In this model, a depreciation leads to an improvement in the trade balance equal to an increase in the demand for money.

(iii) *Change in the money supply* – The effects of changes in the money supply are reported in Table 3. In this model, under fixed exchange rates, we get the result that changes in the domestic money supply are directly related to national welfare which stems from the fixed exchange rate distortion. In essence, an increase in the domestic money supply allows domestic residents to consume more, therefore increasing their welfare. It is also positively related to the consumer's price level. The effect on the activity in the traded sector is negative while it is obviously positive in the domestic non-traded sector. The overall effect on the nominal wage is negative. The trade balance may or may not be deteriorated due to the offsetting effect on the money demand which arises from the induced higher expenditures.

Table 3
Effects of an Expansionary Monetary Policy Under Fixed Exchange Rates (∂M_o^s)

$$\partial U/\partial M_o^s = (1/z_2)\ [z_1\ \phi e_n + e_{nn}] > 0$$
$$\partial P_n/\partial M_o^s = (1/z_2)\ [(z_1/A_n)\ (z_5 + e_{nu}\ q) - e_n U] > 0$$
$$\partial l_x/\partial M_o^s = -\ \partial l_n/\partial E_o = z_1/A_n f_n' < 0$$
$$\partial w/\partial M_o^s = -\ q\ f_n''\ z_1/A_n f_n' < 0$$
$$\partial T/\partial M_o^s = \phi\ [e_n\ (\partial P_n/\partial M_o^s) + e_U\ (\partial U/\partial M_o^s)] - 1$$
$$\partial M^d/\partial M_o^s = \phi\ [e_n\ (\partial P_n/\partial M_o^s) + e_U\ (\partial U/\partial M_o^s)] > 0$$

(iv) *Some Useful Functional Relationships* – The nominal variables in the model, P_n, w, P_x, P_m, T, and M^d, are all homogeneous of degree one in the three variables directly controlled by the government, or q, E, and Ms. On the other hand, all real variables, l_n, l_x, and U, are homogeneous of degree zero in those three variables controlled by the government. Because of these properties, the three policy instruments are linearly dependent. For instance, by Euler's theorem, we have that for P_n and all other nominal variables

$$q(\partial P_n/\partial_q) + E(\partial P_n/\partial E) + M^s(\partial P_n/\partial M^s) = P_n. \tag{5a}$$

Thus, if we know $\partial P_n/\partial_q$ and $\partial P_n/\partial E$, we can determine $\partial P_n/\partial M^s$ from (5a) above. Similarly, for U and all other real variables

$$q(\partial U/\partial q) + E(\partial U/\partial E) + M^s(\partial U/\partial M^s) = 0 \tag{5b}$$

and again if we know $\partial U/\partial q$ and $\partial U/\partial E$, we can compute the value of $\partial U/\partial M^s$ by (5b).

B. Maximizing National Welfare with Balanced Trade

We have argued that when trade balance may be non-zero, U generally is not a good measure of welfare of the small open economy. In this case, two approaches to analyzing the welfare of the economy can be suggested. The first approach is to incorporate the benefits and costs of trade balance deficits or surpluses in the model. Usually this can be done by using an intertemporal budget constraint of the economy so that, for example, a current trade deficit has to be financed by future trade surpluses. The intertemporal welfare of the economy will be a function of the utility levels in all time periods, with U being the appropriate present discounted value of the utility stream. Then the welfare effect of the commodity price control is measured in terms of a change in this intertemporal welfare function. In this case, an increase in current welfare may not imply an increase in the intertemporal welfare if a current trade deficit is offset by lower future consumption and utility. This approach is beyond the scope of this paper, but is certainly subject for future research.[14]

Instead, we take a second approach which is more consistent with the model in the paper. This is the non-economic-objective approach ⟨Bhagwati and Srinivasan [1969]⟩. We first assume that the government, using an intertemporal budget constraint, has determined the appropriate trade balance the economy should have in the current period(and possibly in each of the future periods). The government then tries to maximize national welfare. By Tinbergen's [1952] theory, of course at least two independent poli-

14. See *e.g.* Sachs [1982] for an account of the intertemporal aspects of the current account mentioned above.

cy instruments are needed to achieve the two objectives.

For simplicity, we set the exogenously given trade-balance level at zero, although any other trade-balance levels as an objective can be analyzed in the same way. Choosing a zero trade balance as a non-economic objective is not just a coincidence, because many countries are under pressure to avoid trade imbalances. Thus our approach has a direct policy application.

There are thus two objectives of the government: (a) to maximize the welfare level measured by U; and (b) to have a balance trade, or $T = 0$. In the previous subsection in which only one policy is allowed, it is observed that a change in the utility level is usually accompanied by a change in the trade balance. This is not surprising to anyone who is familiar with Tinbergen's [1952] theory of economic policy intervention because we have two targets and one policy instrument. To achieve two policy objectives, we need two policy instruments.

In this subsection, we will examine the use of different pairs of policies to achieve the two objectives: (i) commodity price control and exchange rate devaluation; (ii) commodity price control and monetary policy; and (iii) exchange rate devaluation and monetary policy.

The problem of the policymaker can be stated in the following general form

$$\underset{\{\psi_i\}}{\text{Max}}\ U(q, E_o, M_o^s; A_x, A_n, P_m^*, P_x^*) \tag{6a}$$

subject to

$$\underset{\psi_i \geq 0}{T = T(q, E_o, M_o^s; A_x, A_n, P_m^*, P_x^*) = 0} \tag{6b}$$

where ψ_i, $i = 1, 2, 3$ is a vector assuming the values $\psi_1 = (q, E_o)$, $\psi_2 = (q, M_o^s)$, $\psi_3 = (E_o, M_o^s)$. Let us first examine the vector $\psi_1 = (q, E_o)$ such that one may attain maximum national welfare and a zero trade balance, or alternatively, two targets with two instruments. According to Tables 1-3, we may compute

$$(\partial q/\partial E_o) \mid_{T=0} = -(\partial T/\partial E_o)/(\partial T/\partial q) > 0 \tag{7a}$$

$$(\partial q/\partial E_o) \mid_{U=U_o} = -(\partial U/\partial E_o)/(\partial U/\partial q) > 0. \tag{7b}$$

Equation (7a) shows the combinations of q and E_o such that the trade balance always equals zero, while (7b) shows the combinations of q and E_o

which delivers a fixed level of national welfare. The equilibrium solution to (6) is the pair q^{**} and E_o^{**} such that (7a) and (7b) are equated. Figure 1 illustrates the equilibrium. The locally concave curve is equation (7a) where the trade balance is zero. The region above the curve represents a trade deficit while the region below represents a trade surplus. The reason is that, for a given exchange rate, a point above means that q is too large and consumption too high resulting in a trade deficit, while a point below means a smaller q and lower consumption resulting in a trade surplus. Equation (7b) delivers a family of convex "indifference" curves with higher q providing higher utility. The equilibrium is at point A.

The interesting aspect of this two-target/two-instrument case is that there is a dual equilibria with respect to the initial conditions where $P_n = q$ and $T = 0$.[15] One possibility is point B where the level of price and exchange rate are too low. In that case, if the policymaker controls the price level to attain the maximum utility, without making use of the exchange rate instrument, it attains point C with a trade deficit; and, in order to reach point B, it needs to further increase q and devalue the exchange rate. Therefore, in this case, the myopic policymaker [the one indifferent about trade balance effects] undershoots the optimal price control. The other possible case is an initial equilibrium at point D, again where $P_n=q$ and $T=0$, but where prices and exchange rate levels are too high. Here, the myopic policymaker would aim at point F, where the control would overshoot the optimal equilibrium at point A. In this case, both instruments should decline in order to reach point A. In effect, the myopic policymaker may fall in a dual equilibria trap.

Another possible vector of instruments is $\psi_2 = (q, M_o^s)$. Tables 1–3 show that

$$(\partial q/\partial M_o^s) \mid_{T=0} = -(\partial T/\partial M_o^s)/(\partial T/\partial q) < 0 \tag{8a}$$

$$(\partial q/\partial M_o^s) \mid_{U=U_o} = -(\partial U/\partial M_o^s)/(\partial U/\partial q) < 0. \tag{8b}$$

Equation (8a) shows the combinations of price control and money supply such that the trade balance equals zero and (8b) shows the combinations of the same variables which delivers a fixed level of national welfare. The equi-

15. The idea here is similar to the dual equilibria in high inflation economies as in Bruno and Fischer [1990].

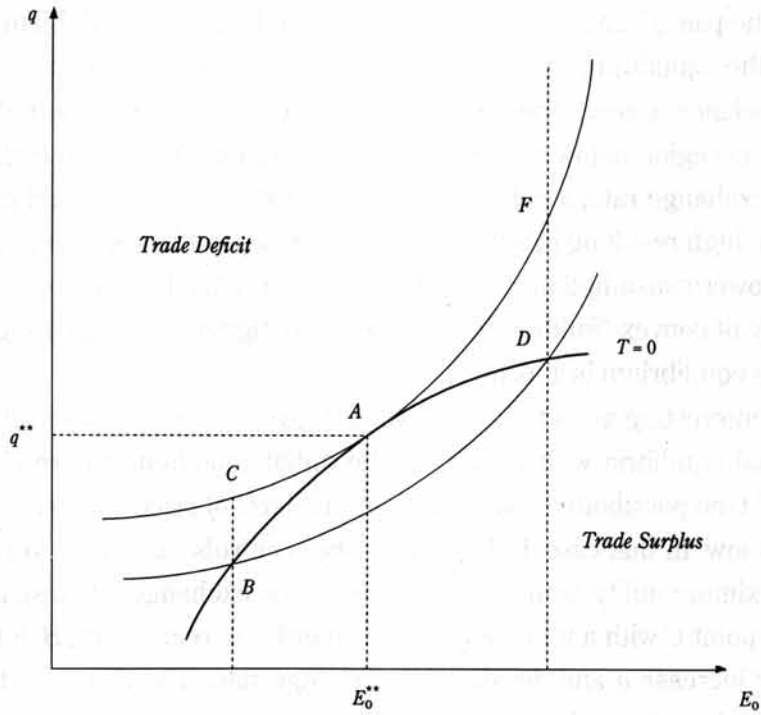

Figure 1
Two Policy Instruments, $\varphi_1 = (q, E_0)$

librium is the pair q^{**} and M_0^{s**} such that (8a) and (8b) are equated. The equilibrium is illustrated in Figure 2. Now, the curve representing equation (8a) is downward sloping and it is the locus of points where the trade balance is zero.[16] The region above the curve represents a trade deficit while the region below represents a trade surplus. The rationale draws on the same argument of the previous case since for a given money supply, a point above means that q is too large and consumption too high resulting in a trade deficit, while a point below means a smaller q and lower consumption resulting in a trade surplus. Equation (8b) delivers a family of downward sloped "indifference" curves with higher q providing higher utility. The equilibrium is at point A.

In this case, the dual equilibria with respect to the initial conditions where

16. This is the result under the assumption that $\partial T/\partial M_0^s < 0$. See Table 3 above.

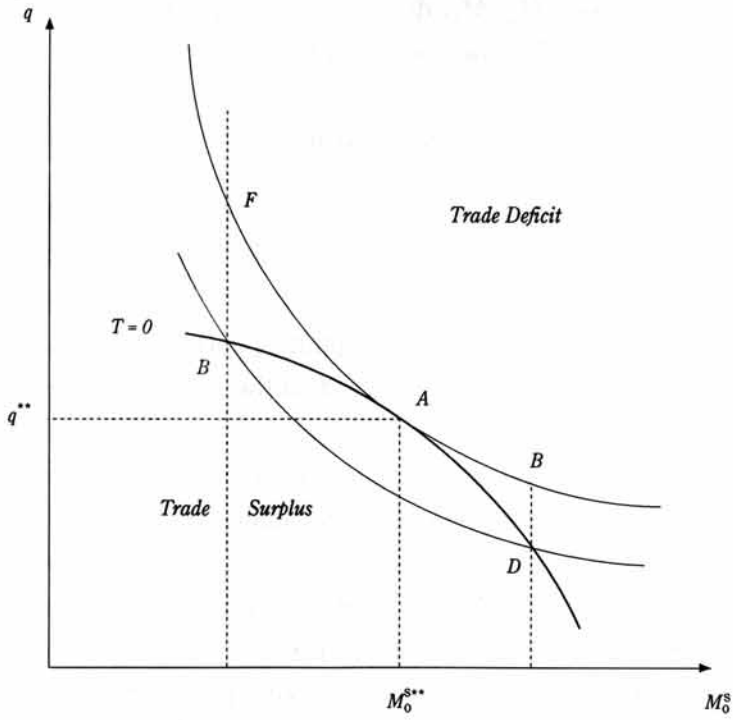

Figure 2
Two Policy Instruments, $\varphi_2 = (q, M_0^s)$

$P_n = q$ and $T = 0$ leads to the following outcome. The possibility of point B is associated with a low money supply and a high price level. In that case, if the policymaker controls the price level to attain the maximum utility, without making use of the money supply instrument, it attains point C, with a trade deficit, taking the price control further away from the optimal equilibrium at point A, therefore overshooting. This case provides the result that, in order to attain the optimal point, the policymaker should choose a lower price control and a higher money supply. On the other hand, if the initial equilibrium is point D and the policymaker aims at maximum utility, it moves the price control in the correct direction but it undershoots the optimal level. In order to attain the optimum, the price control should rise while the money supply should decline. Again, the myopic policymaker may fall in a dual equilibria trap.

Finally, the vector $\psi_3 = (E_o, M_o^s)$ delivers an outcome conceptually similar to the case in Figure 1 and we do not report it here.

C. Technology and Foreign Prices Disturbances

In this section, we examine the effects of the technological and foreign prices shocks on the relevant endogenous variables and the implicit effect on the optimal choices of the policy instruments. The interest here is due to the fact that the policymaker may aim at optimal policies with respect to welfare and/or the trade balance objectives but, at the same time, the economy might be subject to disturbances of real and/or nominal and domestic and/or foreign nature, further complicating the optimal choices.

Tables 4–7 present the basic comparative statics results. Table 4 shows the effects of a technological disturbance in the traded good sector. A higher level of productivity will lead to higher national welfare under the assumption that $f_x e_{nn} > -z_1 f'_x de_n$. With the price of the foreign good determined abroad and the fixed producer commodity price control for the non-traded good, an increase in productivity leads to a higher consumer price for the non-traded good. The sector specific factor will also respond positively while the non-traded factor responds negatively. The nominal wage is positively related as well as the trade balance, and the money demand.

Table 4
Effects of Technological Progress in the Exportable Sector Under Fixed Exchange Rates (∂A_x)

$$\partial U/\partial A_x = P_x(f_x e_{nn} - z_1 f'_x \phi\, e_n)/(z_5\, e_{nn} - e_{nU}\, z_8)$$
$$\partial P_n/\partial A_x = (1/e_{nn})\ [(P_x f'_x z_1 - e_{nu}\, q) - e_{nU}(\partial U/\partial A_x)]$$
$$\partial l_x/\partial A_x = -\,\partial l_n/\partial A_x = -\,P_x f'_x z_1/A_n f'_n > 0$$
$$\partial w/\partial A_x = -\,q\, A_n f''_n\, (\partial l_x/\partial A_x) > 0$$
$$\partial T/\partial A_x = \partial M^d/\partial A_x = \phi\ [e_n(\partial P_n/\partial A_x) + e_U\ (\partial U/\partial A_x)]$$

The table 5 shows the effects of an increase in productivity in the non-traded sector. Higher national welfare obtains if $z_8 > -P_x f'_x e_{nn}$. Since the disturbance now occurs in the non-traded sector, the consumer's price for non-tradables is inversely related to the disturbance. The sector specific factor

responds positively as well as the nominal wage. The effect on the trade balance (money demand) is ambiguous. This is because even though the quantity of non-traded goods consumed is larger, the price is lower leading to an ambiguous total value response. If the price elasticity of demand for the non-traded good is defined as $\varepsilon_{Q,P}$, then when $\varepsilon_{Q,P} < -1$ (elastic demand) (or $\varepsilon_{Q,P} > -1$, inelastic demand) the trade balance and the money demand are positively (or negatively) related to the disturbance.

Table 5

Effects of Technological Progress in the Non-Tradable Sector Progress Under Fixed Exchange Rates (∂A_n)

$$\partial U/\partial A_n = [q\, z_1(z_8 + P_x f'_x e_{nn}) - z_8 f_n]/(e_{nn} z_5 - z_8 e_{nu})$$
$$\partial P_n/\partial A_n = (1/e_{nn})\ [f_n - f'_n\, q\, z_1 - e_{nU}\ (\partial U/\partial A_n)]$$
$$\partial l_x/\partial A_n = -\partial l_n/\partial A_n = q\, z_1/A_n < 0$$
$$\partial w/\partial A_n = P_x f''_x A_x\ (\partial l_x/\partial A_n) > 0$$
$$\partial T/\partial A_n = \partial M^d/\partial A_n = \phi[e_n\ (\partial P_n/\partial A_n) + e_U\ (\partial U/\partial A_n)]$$

The table 6 and 7 show the effects of foreign prices disturbances. In the case of a disturbance in the price of the imported good, table 6, welfare is inversely related, under the assumption that $e_m(E_o + \phi) > -P_m e_{mm}$. An increase in the price of the imported good leads to a decrease in the consumer's price of the non-traded good because the supply of non-tradables as well as exports and wages are not affected. Therefore, the only way the non-traded goods market accommodates to the higher total expenditures in imports is through lower welfare and lower domestic price for non-tradables. In turn, the trade balance and the money demand fall. Thus, an increase in prices of imports has depressing price effects while domestic production is not affected in this model. Finally, the effects of traded goods price disturbances, table 7, are shown to be positive for all endogenous variables except for the nonspecific factor.

Let us now examine the effects of technology and foreign prices shocks on the optimal policy choices. What is the effect of the technology and foreign price disturbances on the optimal policy vectors $\{\psi_i\}$? In the first case, $\psi_1=(q, E_o)$, $\partial A_x > 0$ shifts the locus $T = 0$ upwards to the left in Figure 1. The optimal policy choice varies depending on the shape of the "indifference"

Table 6

Effects of an Increase in the World Price of the Imported Good Under Fixed Exchange Rates (∂P_m^*)

$$\partial U/\partial P_m^* = [e_{nm}z_8 - e_{nn}(P_m\, e_{mm} + E_o e_m + \phi e_m)]/(e_{nn}z_5 - z_8 e_{nu})$$
$$\partial P_n/\partial P_m^* = (1/e_{nn})\ [e_{nm} - e_{nU}\ (\partial U/\partial P_m^*)]$$
$$\partial l_x/\partial P_m^* = -\ \partial l_n/\partial P_m^* = 0$$
$$\partial w/\partial P_m^* = 0$$
$$\partial T/\partial P_m^* = \partial M^d/\partial P_m^* = \phi\ [e_n\ (\partial P_n/\partial P_m^*) + e_U\ (\partial U/\partial P_m^*)]$$

Table 7

Effects of an Increase in the World Price of the Exported Good Under Fixed Exchange Rates (∂P_x^*)

$$\partial U/\partial P_x^* = [-(E_o A_x f_x' z_1/A_n f_n')\,(P_x A_x f_x' e_{nn} - A_n z_8 f_n') + E_o A_x f_x e_{nn}]/(e_{nn}z_5 - e_{nU}z_8) > 0$$
$$\partial P_n/\partial P_x^* = (1/e_{nn})\ [E_o A_x f_x'\, z_1 - e_{nU}\ (\partial U/\partial P_x^*)] > 0$$
$$\partial l_x/\partial P_x^* = -\ \partial l_n/\partial P_x^* = -\ E_o A_x f_x'\, z_1/A_n f_n' > 0$$
$$\partial w/\partial P_x^* = -q A_n f_n''(\partial l_x/\partial P_x^*) > 0$$
$$\partial T/\partial P_x^* = \partial M^d/\partial P_x^* = \phi\ [e_n(\partial P_n/\partial P_x^*) + e_U\ (\partial_U/\partial P_x^*)] > 0$$

curves. Under the assumption of a linear expansion path for the "indifference" curves, the price control increases while the exchange rate appreciates. In the case $\partial A_n > 0$, under the price elasticity of demand for the non-traded good assumption $\varepsilon_{Q,P} < -1$, the result is similar and so it is for the case $\partial P_x^* > 0$, *i.e.* the price control increases while the exchange rate appreciates. Again, the case $\partial P_m^* > 0$ is distinct since the $T = 0$ locus in Figure 1 shifts downward to the left and the price control should be reduced while the exchange rate should devalue in order to attain a new equilibrium.

The case $\psi_2 = (q, M_o^s)$ is such that if $\partial A_x > 0$, $\partial A_n > 0$, or $\partial P_x^* > 0$, the locus $T = 0$ in Figure 2 shifts out to the right and, under the linear expansion path assumption on policy "preferences", both q and M_o^s must adjust upwards. If $\partial P_m^* > 0$, the locus shifts downward and q and M_o^s must decline.

In closing this subsection, it is worth noting that the effects in tables 2, 6, and 7 are all interrelated because all domestic nominal and real variables

are homogeneous of degree zero in $(1/E_o)$, P_x^*, and P_m^*. For example, in the case of nominal wages, we have

$$(1/E_o)[\partial w/\partial(1/E_o)] + P_x^*(\partial w/\partial P_x^*) + P_m^*(\partial w/\partial P_m^*) = 0 \qquad (5c)$$

and if we know $\partial w/\partial(1/E_o)$ and $\partial w/\partial P_x^*$, then we can compute the value for $\partial w/\partial P_m^*$ using (5c) above.

D. The Case of Consumer's Price Control

The analysis in the case of a consumer's price control follows directly from the case analyzed above, *i.e.* the producer's price control. This follows from the symmetry of the system which yields, in general,

$$\partial Z/\partial P_n = (\partial Z/\partial q)\ (\partial q/\partial P_n) + (\partial Z/\partial E)\ (\partial E/\partial P_n) \qquad (9)$$

for $Z = U, P_n, l_x, l_n, w, T, M^d$. In particular, the present section analyzes the case of fixed exchange rates, and, for instance, the effect of a consumer's price control on national welfare is simply given by

$$\partial U/\partial P_n = (\partial U/\partial q)(\partial q/\partial P_n) = -\phi\, e_n/(q\, e_{nU} + z_5) < 0 \qquad (10)$$

as calculated from tables 1–3 above. Obviously, consumer's price controls are inversely related to welfare.

IV. Flexible Exchange Rates

Let us examine the system under an exchange rate policy of flexible rates. Now, equations (3) solve for w, l_x, l_n, P_n, U, and E for a given q. Some algebra shows that the derivative of the consumer's utility with respect to the price control, evaluated at the initial equilibrium where $P_n = q$, is given by

$$\partial U/\partial q = K\,[e_n\,(qe_{nm} + P_m e_{mm}) - e_m\,(q\,e_{nn} + P_m e_{nm})] \qquad (11)$$

17. In effect, this is the reason for the usual argument that in a small open economy a system of flexible exchange rates insulates the domestic economy from foreign price disturbances. Our results above, under fixed exchange rate, confirm the fact that foreign price disturbances do affect domestic prices.

where K is a constant not relevant to the present discussion. Most importantly is that, under the assumption that preferences are homothetic, equation (11) equals zero and the competitive equilibrium under flexible exchange rates is a Pareto optimal equilibrium. In turn, under flexible exchange rates, if the economy is at an initial equilibrium where $P_n = q$, producer's/consumer's market price interventions lower welfare. Moreover, in this case, in a situation of prevailing market price interventions, the lifting of such interventions is welfare improving and should be considered as the undoing of some existing distortion. In view of the welfare result of (11), the case of flexible exchange rates leaves no room for policy intervention. The case of a consumer's price control is identical to (9) above so that it is also trivial.

V. Total Commodity Price Control

In the case of total price controls, or alternatively, the consumer and the producer price are both set at the same level q^T, the system (3) becomes overdetermined. This is because excess demand(or supply) emerges and the equilibrium may be obtained by adding up the conditions (3d) and (3e). In the case of fixed exchange rates the system solves for w, l_x, l_n, U, and T for a given q^T, E_o, M_o^s, A_x, A_n, P_x^*, and P_m^*. The flexible exchange rate case solves for w, l_x, l_n, U, and E for a given q^T, M_o^s, A_x, A_n, P_x^*, P_m^*, and $T = 0$.

Table 8 shows the effects of total commodity price control disturbances on the endogenous variables in the case of a fixed exchange rate. Evaluated at an equilibrium where the control is normalized at $q^T = 1$, the disturbance is inversely related to welfare and interventions may be welfare improving. In order to attain maximum welfare the total price control should be set at

$$q^T = 1 + \phi e_n / [e_{nn} + (z_1 / A_n f_n')] < 1. \tag{12}$$

Table 8

Effects of Total Price Controls Under Fixed Exchange Rates (∂q^T)

$$\partial U / \partial q^T = [-(1 - q^T)(e_{nn} + z_1 / A_n f_n') + \phi e_n] / (z_5 + e_{nU})$$
$$\partial l_x / \partial q^T = -\partial l_n / \partial q^T = z_1 < 0$$
$$\partial w / \partial q^T = P_x A_x f_x'' z_1 > 0$$
$$\partial T / \partial q^T = \partial M^d / \partial q^T = \phi [e_n + e_U (\partial U / \partial q^T)]$$

The case of flexible exchange rates with total price controls delivers intractable expressions and we do not report them here. However, it is worth noting that if the initial equilibrium is $P_n = q^T$, the system is at a Pareto optimum as in section IV above.

VI. Concluding remarks

We have studied some examples of price controls in a general equilibrium competitive monetary framework of a small open economy. Our model highlights the Pareto improving role of policy in the case of fixed exchange rates. We have found that a combination of a pair of policy instruments, $\psi_1 = (q, E_o)$, $\psi_2 = (q, M_o^s)$, or $\psi_3 = (E_o, M_o^s)$, leads to maximum welfare and balanced trade. The result is general for producer's and consumer's commodity price controls under fixed exchange rates. However, a myopic policymaker may find itself in a dual equilibria trap. We have examined the role of technology and foreign prices shocks on the endogenous variables and the optimal policy choices and found that import price disturbances under fixed exchange rates are particularly adverse to domestic prices and welfare. In the case of flexible exchange rates, we have shown that the economy is at a Pareto optimal equilibrium rendering the role of policy interventions redundant. Total price controls have a more obvious distortionary effect since excess demand/supply in the goods markets emerges. Still, the total price control may lead to maximum welfare in the case of fixed exchange rates.

The non-economic-objective approach to analyzing trade balance and welfare maximization is simple and provides us much insight into the use of price controls. However, as Bhagwati and Srinivasan [1969] noted, whether an objective is treated as economic or non-economic is a matter of convenience.

Also, in the above analysis we assumed that the economy has no monopoly power abroad in the sense that it faces a given external terms of trade, $(P_m/P_x) = (P_m^*/P_x^*)$. Relaxing this assumption means that actions in the domestic economy can possibly change world prices, say the large open economy case. Let's assume that the export supply function of the rest of the world of each good is "well behaved" in the sense that it is continuous and positive in prices. First, consider the case in which the exchange rate is fixed. As Table 1 shows, a price control in the domestic economy lowers its production of

the exportable under a given world price. This implies that the external terms of trade tend to go up, thus reinforcing the positive effects (at least at the initial price level) of the price control on the per-period welfare. Now, suppose instead that the domestic currency is devaluated. Table 2 also shows that this policy also causes a drop in the output of the exportable good, but an improvement in the external terms of trade. This benefits the economy's per-period welfare, but it works against the direct effect of the devaluation on welfare. Thus, the net welfare effect is ambiguous in this case. Finally, using the same argument applied to Table 3, it can be shown that an expansionary monetary policy will lower the output of the exportable good, adding to the positive effect on welfare due in part to the resulting improvement in the external terms of trade.

In the present paper, our focus is on the effects of price controls on welfare and trade balance. What we have not done is to explain how the optimal trade balance levels are determined. To do this, an intertemporal model is required. Thus, our work can be regarded as the first step toward a fuller understanding of intertemporal welfare maximization under price controls.

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