Financial Market Linkages and the International Transmission of Fiscal Policy

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1. Introduction

The conduct of fiscal policy increasingly takes place in a global setting. As international economic integration proceeds in communication, trade, and financial markets, there is increased interest in learning about the channels through which one country's fiscal policies affect other countries. Of specific concern over the past ten years has been the international effect of high fiscal deficits in the United States. There is a widespread view that fiscal deficits raise real interest rates, reduce saving, crowd out investment domestically and abroad, and lead to large trade deficits. Figure 1 plots the fiscal deficit and the trade deficit for the U.S. over the postwar period. Although the relationship does not appear to be strong throughout the entire sample period, the two deficits do seem related over the past twenty years.

The primary goal of this paper is to explore the dominant channels of influence of fiscal policies on economic activity at home and abroad. In particular, we are interested in discovering whether the extent of international linkages through financial markets is important for the international transmission of fiscal disturbances. Although much of the empirical literature treats the fiscal deficit as the policy variable of interest, we take a more disaggregated view, treating variations government purchases separately from variations in tax rates. In the United States, the relevant taxes are distortional, so that variations in taxes have direct effects on marginal decisions by private individuals. Thus the macroeconomic effects of tax cuts are likely to differ importantly from the effects of increases in government purchases, even if the two interventions have identical effects on the fiscal deficit. Figure 2 plots U.S. government purchases and tax rates as a share of GNP over the postwar period. Clearly, the recent increase in U.S. fiscal deficits are due to a combination of increases in government expenditure and decreases in tax rates.

The paper is structured as follows. Section 2 describes the basic, two–country equilibrium model used to study the transmission of fiscal shocks. This one–good

model highlights the consumption smoothing, risk sharing, and portfolio composition motives for international trade in consumption goods and financial assets. Section 3 explores the dynamic effects of permanent and temporary shocks to government expenditures and taxes. In comparing the effects of permanent versus temporary shocks, the focus is on isolating the relative importance of wealth and various substitution effects as the persistence of the shocks changes. Section 4 investigates whether our model can explain, in a stylized sense, the "twin deficit" phenomenon of the 1980's. This section also reviews existing empirical findings on the relation between government policy and economic activity, with particular attention to empirical investigation of the effects of deficits. In addition, we propose further empirical work which the quantitative theory of this paper suggests would be informative concerning the international transmission of fiscal policy. Section 5 briefly summarizes the main results of the paper and discusses avenues for future research.

2. The Model

This section develops a two–country equilibrium model of international trade. There is one consumption/investment good which is produced by both countries. Because of the one–good assumption, international trade takes place for three reasons: for consumption smoothing; for risk–pooling; and to locate physical capital to maximize owners' wealth.[1] This model is closely related to the paradigm developed by Baxter and Crucini [1991,1992], so our presentation of the model is quite brief. We consider two alternatives for financial markets: a complete–markets economy in which all contingent securities are assumed to be tradable internationally; and a

[1]These motives for trade are likely to be the dominant ones for the determination of interest rates, saving, and investment that will be the focus of this paper. Potential extensions to multi–good economies are briefly discussed in Section 5.

restricted asset market economy in which international financial trade is restricted to non–contingent real debt. The main difference arising from restrictions on asset trade appears in the flow constraints (budget constraints), as summarized in Sections 2.2 and 2.3. Foreign country variables are denoted by stars, and all variables are in national per capita terms.

2.1 Preferences, technology, and endowments

Individuals consume two goods: a produced consumption good, C, and leisure, L. They maximize expected lifetime utility, given by:

$$E_0 \sum_{t=0}^{\infty} \beta^t \frac{1}{1-\sigma} [C_t^{\theta} L_t^{1-\theta}]^{1-\sigma} \qquad \text{home country;} \qquad (1)$$

$$E_0 \sum_{t=0}^{\infty} \beta^t \frac{1}{1-\sigma} [C_t^{*\theta} L_t^{*1-\theta}]^{1-\sigma} \qquad \text{foreign country.} \qquad (2)$$

In each country, individuals are subject to the constraint that hours worked in the marketplace plus hours of leisure cannot exceed the time endowment, normalized to one unit:

$$1 - L_t - N_t \geq 0 \qquad \text{home country;} \qquad (3)$$

$$1 - L_t^* - N_t^* \geq 0 \qquad \text{foreign country.} \qquad (4)$$

Production functions exhibit constant returns to scale. Production of the single final good requires as input labor and capital. Capital used in production in a specific country is not necessarily owned by residents of that country. Thus K_t represents capital in place in the home country, not necessarily capital owned by residents of the home country. Labor is internationally immobile. Letting N_t denote labor employed in the home country, the production functions are given by:

$$Y_t = A_t K_t^{1-\alpha} (X_t N_t)^{\alpha} \qquad \text{home country;} \qquad (5)$$

$$Y_t^* = A_t^* K_t^{*1-\alpha^*} (X_t^* N_t^*)^{\alpha^*} \qquad \text{foreign country} \qquad (6)$$

In these production functions, the variables X_t and X_t^* represent the level of purely labor–augmenting technical change in the home and foreign countries, respectively, and each grows at a common, constant gross rate: $\gamma = X_{t+1}/X_t = X_{t+1}^*/X_t^*$. The variables A_t and A_t^* represent the stochastic component of the productivity variable, and are assumed to follow a vector Markov process. New capital goods are internationally mobile, subject to costs of adjustment governed by the function $\phi(I/K)$, with $\phi>0$, $\phi'>0$, $\phi''<0$. Capital accumulates over time according to:

$$K_{t+1} = (1-\delta)K_t + \phi(I_t/K_t)K_t \qquad \text{home country;} \qquad (7)$$

$$K_{t+1}^* = (1-\delta)K_t^* + \phi(I_t^*/K_t^*)K_t^* \qquad \text{foreign country.} \qquad (8)$$

The government in each country purchases output, levies distortionary taxes, and transfers resources to private individuals. Letting G_t denote government purchases of final output, τ_t denote the tax rate on output, and TR_t denote transfers, the government's flow budget constraint is:

$$G_t + TR_t = \tau_t Y_t \qquad \text{home country;} \qquad (9)$$

$$G_t^* + TR_t^* = \tau_t^* Y_t^* \qquad \text{foreign country.} \qquad (10)$$

The government chooses policy rules for purchases and tax rates, with transfers adjusting so that (9) and (10) hold period–by–period. Negative transfers are interpreted as lump–sum taxes. Furthermore, because Ricardian equivalence holds in this economy, variations in transfers can be reinterpreted as variations in the level of government debt which will be retired using the proceeds of future changes in lump–sum taxes.

Since the consumption/investment good is internationally mobile, there is a single world resource constraint for this good. Letting π denote the fraction of the world population residing in the home country, the world resource constraint is:

$$\pi[Y_t - C_t - I_t - G_t] + (1-\pi)[Y_t^* - C_t^* - I_t^* - G_t^*] \geq 0. \qquad (11)$$

2.2 The complete–markets economy

In the complete markets economy, individuals in the two countries are free to trade any state contingent asset they wish. Thus, in equilibrium, individuals will bear no idiosyncratic risk. The equilibrium of this economy consists of a set of functions describing the behavior of endogenous variables such as consumption, saving, investment, etc., as functions of the exogenous shocks to the model (i.e., the productivity shocks). The model is transformed to render it stationary, as discussed in Baxter and Crucini [1991,1992]. Lowercase letters are used below to denote transformed variables.

2.3 The bond economy

The model differs from the complete markets economy in that international trade is restricted to goods and non–contingent debt. The bonds are assumed to be one–period, real, risk–free discount bonds. Let r_t denote the endogenously–determined world rate of return on risk–free securities, and let $R_t \equiv (1+r_t)^{-1}$ denote the price per unit of one–period discount bonds purchased in period t. B_{t+1} denotes the quantity of bonds purchased in period t (maturing in t+1). Letting $b_t \equiv B_t/X_t$ denote the value of bonds in the transformed economy, the flow budget constraints are:

$$\gamma R_t b_{t+1} + c_t + i_t + g_t \leq y_t + b_t \tag{12}$$

$$\gamma R_t b^*_{t+1} + c^*_t + i^*_t + g^*_t \leq y^*_t + b^*_t. \tag{13}$$

Letting $\underline{b}$ denote the aggregate quantity of debt in the world economy, bond market clearing requires that:

$$\pi\, b_t + (1-\pi) b^*_t = \underline{b}\ . \tag{14}$$

2.4 Model solution and calibration

The competitive equilibrium for both the complete markets and bond economies is computed using the log–linear approximation method of King, Plosser and Rebelo [1987]. The calibration of preferences and technology is described in Baxter and Crucini [1992], as summarized in Table 1. The steady state share of government purchases as a fraction of GDP is set at .20 and the steady–state tax rate, τ, is set at .30, with transfers accounting for the difference (10% of GNP). These figures were chosen to correspond with recent U.S. experience (see Baxter and King [1992]). Finally, we set $\pi = 0.50$, so that the two countries in the model are equally–sized. Thus one country is roughly the size of the U.S., with the other country representing an aggregate of all other countries.

3. The Dynamic Effects of Permanent and Temporary Fiscal Shocks

This section explores the channels by which shocks to taxes and government purchases are transmitted to the domestic and foreign economies. In particular, we investigate whether the transmission of shocks is sensitive to the extent of international financial market linkages. Our analysis builds on that of Arvanitis [1991] who studied the international transmission of tax and spending shocks in a two–country, complete markets setting. As in that paper, we compare the effects of temporary and permanent shocks. This is motivated by the observation that government purchases in the postwar U.S. appear to have both temporary and permanent components, with the temporary components mainly associated with war episodes (see Figure 2). Correspondingly, there have been apparently permanent increases in average tax rates. In the early 1980's, the combination of the Reagan rearmament and the tax reforms which reduced average tax rates led to unprecedented peacetime deficits. This combination of increased government expenditure and reduced taxes may be are unsustainable in the long run because of

their implications for government solvency. However, these policy shifts have been quite persistent, lasting several years at least. This motivates our interest in studying the effects of fiscal disturbances which are persistent, and possibly permanent. Specifically, government purchases and tax rates are assumed to follow first–order autoregressive processes, as follows:

$$g_t = (1-\rho_g)g + \rho_g g_{t-1} + \epsilon_{gt} \quad |\rho_g| \leq 1 \tag{15}$$

$$\tau_t = (1-\rho_\tau)\tau + \rho_\tau \tau_{t-1} + \epsilon_{\tau t} \quad |\rho_\tau| \leq 1 \tag{16}$$

Throughout, we assume that the government maintains its flow budget constraint through variations in "Ricardian" debt, defined as debt which will be retired at some point in the future by means of increases in lump–sum taxes (decreases in transfer payments).[2] To standardize the experiments, in each case we consider an innovation in the policy variable that would lead to a contemporaneous, one–commodity–unit increase in the flow fiscal deficit if there were no response in labor input.

3.1 A permanent increase in government purchases

Consider an unexpected, permanent increase in home country government purchases equal to one commodity unit: $\Delta g = 1$. The dynamic response to this shock is plotted in Figure 3. In each panel, the solid line denotes the equilibrium response in the complete markets economy, and the dashed line plots the response of the bond economy.

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[2]This financing method was chosen for simplicity — if debt will be retired by means of future lump–sum taxes, the equilibrium in this infinite–horizon, representative–agent model is invariant to the date at which the tax increase will take place. Because individuals' responses are invariant to financing via lump–sum taxes or financing via "Ricardian debt," we do not distinguish these in the governments' flow budget constraints, (9) and (10). Other plausible specifications might allow the possibility that the debt would be retired by increases in distortionary taxes, or by reductions in government expenditure. Here, the expected date of the intervention is important, as in Dotsey and Mao [1992]. Thanos Arvanitis and I are currently investigating the implications of these plausible alternatives.

Because government purchases enter only in the resource constraint, the permanent increase in government purchases acts as a negative wealth shock. Under complete markets, individuals have agreed in advance to "pool" this type of risk, so that the negative wealth shock is shared equally by the two countries. Correspondingly, the responses of output, consumption, investment, labor supply, real wages, and stock prices are identical across the two countries under the complete markets regime. Because of the negative wealth shock, in the long run both countries reduce consumption, increase labor supply, and increase investment (recall that in the neoclassical model the long run capital–labor ratio is invariant to the scale of government expenditure). Along the transition path, real wages are low while Tobin's "q" is high, relative to steady–state levels. The real interest rate rises on impact, but only about 5 basis points. Under complete markets, the only difference across the two countries is in the behavior of the trade balance: the permanent deterioration of the home country trade balance arises because foreigners permanently provide half of the additional output demanded by the government.[3]

When asset trade is restricted to noncontingent debt, the responses differ dramatically in several respects. First, the wealth effect of the government purchase shock is borne almost completely by residents of the home country.[4] As a result, the decrease in consumption and the increase in labor supply are more pronounced in the home country than in the prior, complete–markets case. The larger response of domestic labor input induces a larger positive response of home country investment and Tobin's q, and a larger negative response of the home country real wage. The

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[3] The home country trade balance is defined as Y–C–I–G, where Y is gross domestic product (GDP). The current account can differ from the trade balance defined in this way if there are cross–country transfers or net international flows of interest payments which are not included in GDP. In the example in the text, the transfer from the foreign country is not counted in GDP, so that the home country registers a trade deficit (but not a current account deficit).

[4] The wealth effect is not borne completely by the home country because of the presence of distortionary taxation in both countries.

foreign country's response is mainly due to substitution effects associated with temporary movements in the world real interest rate and the foreign real wage. The rise in the real interest rate induces a decline in foreign consumption on impact, but this decline is much smaller in absolute value than under complete markets. The decline in the foreign real wage rate and the rise in the real interest rate have offsetting effects on the level of foreign labor input — in this parametric case, the net effect is to induce a short run increase in foreign labor supply.

In the new steady state, real wages in both countries and the real interest rate are restored to their initial levels, yet foreign consumption is above its initial steady state level, while investment (and the capital stock) is lower, as is the level of foreign labor input. How can we understand this? The key lies in the behavior of foreign holdings of debt, which rise steadily along the transition path. Domestic residents temporarily buffer their consumption path from the full effect of the negative wealth shock by selling part of their holdings of the debt instrument to residents of the foreign country (the price of the debt instrument is low along the transition path since the real interest rate is high). In the new steady state, residents of the foreign country sustain a higher consumption level with a lower level of labor input by consuming the returns on their increased stock of debt. The decline on impact of foreign country investment thus stems from two factors: (i) the high demand for investment goods in the home country; and (ii) the anticipation of a lower steady state level of investment in the foreign country. Consequently, Tobin's "q" declines on impact in the foreign country under restricted asset markets (recall that it increased under complete markets).

3.2 A permanent decrease in distortionary taxes

Now consider a permanent decrease in the home country's output tax rate, τ. To make this experiment comparable to that of section 3.1, the tax shock, $\Delta\tau$ is set

so that the impact effect on the fiscal deficit would be one unit, assuming no endogenous response to the shock (i.e., $\Delta\tau\underline{y} = -1$, where $\underline{y}$ is the initial steady state level of domestic output). Figure 4 plots the dynamic response to this shock under the two asset structures.

Under complete markets, the response in the two countries is no longer symmetric, as it was in the case of an increase in government expenditure. Because labor is internationally immobile, individuals cannot avoid the incentive effects associated with variations in taxation. Under complete markets, the optimal risk–pooling arrangement involves an increase in home country labor input in response to the tax cut; home country laborers are partly compensated for working so hard by having a consumption path that is higher than that of the foreign country (so long as $\sigma \neq 1$). Because the foreign country is now the relatively high–tax location, the equilibrium under complete markets implies lower foreign country labor input along the transition path and in the new steady state. Similarly, because capital goods are less heavily taxed in the domestic economy, the equilibrium response under complete markets is an increase in home country investment and a decrease in foreign country investment. The tax cut correspondingly leads to a domestic stock market boom (an increase in Tobin's "q") accompanied by a decline in the foreign stock market. The home country trade balance declines sharply as a result of the domestic output boom which is fueled, in large part, by inflows of foreign capital. Further, the additional consumption goods provided under complete markets to domestic laborers leads to larger increases in the trade deficit.

In the bond economy there are again important differences in home and foreign responses to the tax cut. First, the absence of complete risk–pooling and the accompanying optimal labor insurance means that domestic residents receive the bulk of the positive wealth effect of the tax cut. Correspondingly, domestic consumption increases more in the bond economy, while labor input increases by less. The

smaller increase in domestic labor means that the marginal product of domestic capital increases by less, leading to a smaller increase in home country investment and a smaller rise in the value of the domestic stock market. In the foreign country, as in our analysis of domestic government purchases under restricted asset markets, there are mainly substitution effects. One substitution effect is associated with the temporary increase in the real interest rate, which rises by about 5 basis points. The other substitution effect arises from temporary variation in the foreign real wage. Both substitution effects operate to induce a decline in foreign consumption on impact, with an increase in labor supply. Foreign investment and the foreign stock market both fall, but by less (in absolute value) than under complete markets. Finally, foreign holdings of debt increase along the transition path and in the new steady state — this was also the case in our analysis of the government purchase shock. However, the economic mechanisms at work in the present case are different from those discussed above. Recall that, in the case of increased home country government purchases, domestic residents used sales of debt to smooth their consumption path in the face of this negative wealth shock. In the present case, with a tax cut, domestic residents receive a positive wealth shock, while the foreign country has become the relatively high–tax location to produce output. Thus, in equilibrium, the foreign country supports part of its consumption by means of interest on debt, rather than by means of relatively highly–taxed labor input.

3.3 Temporary shocks to government purchases

This sub–section and the next study the effects of temporary fiscal shocks. Permanent and temporary shocks differ primarily in the relative strength of wealth and substitution effects, as stressed by Barro [1981], Hall [1980], and many other authors. These two sections investigate how the relative strength of these effects changes with the persistence of the shock.

Consider an unexpected, temporary shock to government purchases, where purchases are assumed to be the AR(1) process specified in equation (15). Following King [1990], the dynamic response of consumption and labor input to an exogenous shock can be decomposed into three components: (i) a wealth effect; (ii) an intertemporal substitution (or interest rate) effect; and (iii) a wage effect. Table 2 presents information on the relative strength of wealth and substitution effects on consumption and leisure for temporary and permanent shocks to home country government expenditure. In all cases, the initial shock is standardized to $\Delta g_0 = 1$ commodity unit. The first column in each panel gives the value of ρ_g; the second column gives the wealth effect under complete markets. The third and fourth columns show the impact and long run effect of the shock (i.e., the combined wealth and substitution effects) under complete markets. The right–hand part of each panel gives the results for the incomplete markets model.

From Table 2 we see that the wealth effect of an increase in government purchases is negative in both countries, regardless of asset structure. The wealth effect increases dramatically as the persistence of the shock approaches one, and is largely concentrated in the home country under incomplete markets. In the short run (i.e., on impact), the substitution effects on consumption and labor input reinforce the wealth effects. Under complete markets, there is zero long run effect on consumption, labor input, investment, and output, unless the shock is permanent. Under incomplete markets, by contrast, the wealth redistribution induced by the shock leads to long run decreases in consumption and leisure in the home country, and equally–sized, long run increases in consumption and leisure in the foreign country.[5] The strength of these long run changes increases with the persistence of

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[5] The fact that temporary shocks can have permanent effects in an open economy model with incomplete asset markets has previously been noted by Turnovsky and Sen [1991] in the context of a small open economy model. However, they state that "...this result...is generated by the assumption that the domestic consumer's time discount rate

the shock, although they do not rise dramatically with ρ_g until this parameter exceeds about 0.95.

To illustrate the dynamic response of a temporary shock to government purchases, Figure 5 plots the response to a one–unit increase in government purchases with $\rho_g = 0.90$. This initial shock is the same size as in Section 3.1 above ($\Delta G=1$), and Figure 5 can be compared with Figure 3 to see the between temporary and permanent shocks to government expenditure. One obvious difference is that permanent shocks lead to permanent changes in output, consumption, investment, labor input, and net exports, regardless of market structure. Temporary shocks lead to permanent changes in these variables only under incomplete markets. Another important difference between temporary and permanent shocks lies in the behavior of investment and, correspondingly, in the behavior of Tobin's "q" (also interpretable as the "stock market"). With temporary increases in government purchases, investment and the stock market both decline on impact because the return to capital is temporarily low. In the permanent shock case, however, the new long run will involve a higher level of both labor and capital, and Tobin's "q" rises on impact to stimulate the necessary additional investment. Finally, although the impact effect on wages is much larger in the case of temporary shocks, the impact effect on the real interest rate is about the same in both cases and is quite small — about 5 basis points.

3.4 Temporary shocks to τ

Now, consider temporary variations in the tax rate, τ. Table 3 explores how the wealth and substitution effects of the shock to taxes change as the shock

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equals the exogenously determined foreign real interest rate." (page 21). It is clear from our analysis that this assumption, while necessary for a steady state, is not the crucial one. Rather, the critical determinant of whether temporary shocks have permanent effects is whether asset markets are complete.

becomes more persistent. As with government purchases, the wealth effect of tax shocks are smaller, the less persistent is the shock. However, the tax shocks differ from the government purchase shocks in that the sign of the home country wealth effect depends on the extent of financial linkages. Under complete markets, for example, the tax cut has a negative home country wealth effect on consumption and leisure. Under incomplete markets, by contrast, the tax cut has a positive wealth effect. This can be understood as follows. Under complete markets, the optimal response is for the recipient of the tax cut to work much harder — in fact, so much harder that he is worse off, ex post. With asset trade restricted to noncontingent debt, home country residents do not engage in these risk–sharing arrangements, and they further hold all claims to the home country capital stock. When the tax cut makes the capital more productive, the home country residents receive most of the benefits.

An important difference between the permanent and temporary shocks lies in the behavior of labor input. With permanent shocks, long–run labor input rises in the home country under both asset structures, although the increase is larger under complete markets. With temporary shocks, the long run effect is zero under complete markets, and is negative in the bond economy. The decline in long–run labor input under complete markets with temporary shocks occurs for reasons discussed earlier. Individuals in the home country purchase debt during the period of temporarily low tax rates, and use the interest on the higher stock of debt to support higher consumption and leisure after the tax cut disappears. This can be seen in Figure 6, which plots the response to a tax cut with persistence $\rho_{\tau} = 0.90$. Figure 6 also shows that the differences between the complete and incomplete markets responses are relatively minor, as was true in the case of temporary shocks to government purchases.

4. The Twin Deficits

This section investigates whether this open economy, neoclassical model predicts a "twin deficits" phenomenon by which fiscal deficits are accompanied by large trade and current account deficits. In addition, we review related empirical evidence and suggest further empirical work.

4.1 Model predictions

We continue to assume that variations in government purchases and distortionary tax rates are financed by changes in "Ricardian" debt, so that they result in variations in the government deficit. We further assume that the debt is not retired over the period covered by the impulse response (80 quarters). Figure 7 plots the response of the home and foreign country "twin deficits" to the fiscal shocks studied in Section 3. Taking the fiscal experiments in the same order considered earlier, Figures 7–A and 7–B plot permanent changes in home country purchases and tax rates, respectively, while Figures 7–C and 7–D plot persistent, but temporary changes. Recall that all experiments are standardized so that the impact effect of the shock on the home country's fiscal deficit would be one commodity unit, if there were no private sector response.

A striking result is that the model generically predicts the "twin deficits" phenomenon in the country in which the shock originates (in this case, the home country). On impact, the current account and trade deficits increase by one–third to one–half as much as the fiscal deficit. This is true whether the shock is a spending increase or a tax cut, and whether the shock is permanent or simply highly persistent. Further, the predictions for the impact effect on the "twin deficits" is largely independent of financial structure.

What are the implications for the foreign country? In most cases, the "twin deficits" phenomenon in the home country is accompanied by a "twin surpluses"

phenomenon in the foreign country, at least on impact. With incomplete markets, however, increases in home country government purchases lead the foreign country to experience long run fiscal and trade deficits (albeit small ones), even though foreign fiscal policy has not changed. This can be understood as follows. When the home country increases government purchases and asset markets are incomplete, the foreign country responds by accumulating bonds and decreasing steady state labor input. The steady state capital account surplus is offset by the trade account deficit, and the decline in labor input means that tax revenues no longer offset foreign government expenditures.

When the home country cuts tax rates, whether the cuts are permanent or temporary, and regardless of the asset structure, the foreign country will inherit a twin deficits phenomenon at some point along the transition path. Consider, for example, a temporary decrease in the tax rate, as plotted in Figure 7–D. The home country trade account registers a surplus after less than two years, while the foreign country finds itself with a trade deficit. At the same time, the decline in foreign country investment and labor input leads to a foreign fiscal deficit.

4.2 Deficit policy?

Throughout this paper, we have considered tax and expenditure policies separately. However, most of the empirical literature (discussed in section 4.3 below) focuses on fiscal deficits as the policy instrument, rather than on tax and expenditure policies separately. Our results show that this focus on deficits is misplaced. In the United States, for instance, fiscal deficits arise either from increase in government purchases, or from variations in tax receipts, sometimes caused by changes in distortionary tax rates. Comparison of Figures 3–7 clearly show that the macroeconomic effects of tax shocks differ importantly from the response to expenditure shocks, even when the shocks have been standardized to have a common,

one–unit impact effect on the fiscal deficit in the absence of any endogenous response. For example, domestic consumption and real wages rise with the tax cut, but both fall with the spending increase.

Finally, our results suggest that the macroeconomic responses to some policy shocks depend on the persistence of the shock. Table 4 shows how the fiscal, trade, and current account deficits, as well as the real interest rate, consumption, and investment respond to policy shocks of varying persistence. Only the results for the incomplete markets economy are presented. It is clear from this table that the effects of fiscal shocks on the trade deficit and on interest rates are generally sensitive both to the type of shock, as well as its expected persistence. Looking first at government purchases, the impact effect on the current account and trade deficits is largely invariant to the persistence of the shock. However, the interest rate effect is very sensitive to persistence, with much larger effects associated with more temporary shocks. Further, as persistence rises, there are greater decreases in consumption and greater increases in investment. Turning to the effects of tax shocks, we find that the "twin deficits" phenomenon does not occur when the shocks have low persistence. Apparently, when the tax cuts are highly temporary, the additional private saving induced by a tax cut is more than enough to outweigh the increase in the fiscal deficit, so that the current account registers a surplus. Correspondingly, the sign of the interest rate effect of tax cuts depends critically on the persistence of the shock. Finally, it is interesting that there are roughly equal impact effects on the current account and interest rates of a permanent increase in government purchases and a permanent tax cut.[6]

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[6]Kollman [1992] also studies the "twin deficit" phenomenon in a model closely related to this one. He argues that tax shocks in particular may be important for explaining the persistence of the U.S. trade deficit.

4.3 Implications for empirical analysis

There are two primary branches of the empirical literature on the international effects of fiscal shocks. One branch starts from the observation that the interest rate is the key mechanism through which variations in domestic fiscal policy lead to macroeconomic effects at home and abroad. The second branch focuses directly on the relationship between fiscal deficits and trade or current account deficits. We review the main findings of each branch of this literature below. However, the results of both branches may be summarized as being largely inconclusive on whether fiscal deficits are important for interest rates or current account balances. The theoretical results of this paper suggest some reasons why prior empirical work may have been inconclusive, and we suggest some further empirical work that may shed light on the important linkages.

4.3.1 *Fiscal deficits and interest rates*

As noted above, the standard analysis of the effects of fiscal policy stress the interest rate as the key avenue by which tax and expenditure shocks are transmitted to the economy by means of intertemporal substitution on the consumption side, and crowding out on the investment side. Several authors have attempted to uncover an empirical link between fiscal deficits and interest rates. Some authors conclude that there is no link — see, for example, Dwyer [1982], Evans [1985, 1987], and Plosser [1982, 1987]. Others, however, do find a link between deficits and interest rates, notably Barro [1987]. Barro studied temporary fluctuations in government purchases the U.K. over a long sample period. Specifically, he focused on wartime episodes of three to seven years' duration. His regression analysis found that a 1% increase in

temporary spending increased the long–term interest rate by about three to six basis points, depending on the sample period.[7]

Table 4 shows that the interest rate effect of "deficit shocks" depends heavily on (i) whether the deficit is due to an increase in government purchases or a decrease in tax rates; and (ii) the expected persistence of the shock. The largest predicted effects are for low–persistence shocks to government purchases. This may explain why Barro's [1987] analysis of wartime episodes is one of the few studies that uncovered an empirical link between deficits and interest rates. When shocks are more persistent, the predicted interest rate effects are very small.

These results suggest that, at a minimum, empirical analyses should distinguish between shocks to taxes and shocks to government purchases. When these shocks are not highly persistent, even the sign of the interest rate effect differs across the two types of interventions. When the shocks are permanent, tax shocks have roughly equivalent effects to purchase shocks on interest rates and the current account. However, this is the only case in which the two sources of deficits have similar effects. Except for low–persistence shocks to purchases, the interest rate effects of fiscal shocks in open economies are predicted to be small, even when the shocks occur in "large" economies. These considerations may explain why previous empirical work attempting to detect the real interest rate effects of government deficits may have failed to uncover a significant effect.

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[7] I ran some experiments (not reported elsewhere in the text) that correspond to "wars" (in one country) of three to seven years, where a "war" is defined as a 1% increase in government purchases that is unexpected on impact but subsequently individuals know that the war will last for exactly the specified duration. The parameterization of the model is otherwise the same. I found that the model predicted a world interest rate effect of about three to seven basis points, which is in line with Barro's results.

4.3.2 *The "twin deficits"*

The empirical literature on the "twin deficits" is also mixed on whether fiscal deficits lead to significant movements in the trade or current account deficits. The earliest in–depth study, conducted by Milne [1977], regressed the current account on the fiscal deficit for thirty–eight countries. She found a significant relationship between the two deficits in some, but not all countries. Summers [1986] claims to find a significant link between the two deficits in the United States. Bernheim [1988] undertakes case studies of the United States and her five largest trading partners, and argues that there is a link between the two deficits in nearly every case, once a variety of special factors are taken into account. His estimate is that a $1.00 fiscal deficit in the U.S. leads to an approximately $0.30 deterioration of the current account. (Recall that our model predicts a response of approximately this size — see Figures 7(A)–(D)). Miller & Russek [1989] study the secular or "long–run" relationship between the current account and fiscal deficits, and conclude that there is a relationship between the two deficits only in post–Bretton Woods period. Darrat [1988] and Abell [1990] also find evidence of a link between the twin deficits, while Evans [1989] and Enders and Lee [1990] do not. Dewald and Ulan [1990] argue that the link between the two deficits arises from measurement error.

Our theoretical results can once again shed some light on potential reasons for the mixed empirical results. As in the case of the deficit–interest rate link, the relation between the "twin deficits" is sensitive to the source of the deficit, as well as its expected persistence. Referring again to Table 4, we see that low–persistence increases in government purchases lead to fiscal and current account deficits, while low–persistence cuts in taxes lead to current account surpluses. When the policy interventions are permanent, both tax cuts and spending increases lead to twin deficits of similar size. Interestingly, the impact effect on the trade and current accounts of a government purchase shock is nearly invariant to the expected

persistence of the shock. This is counter to Ahmed's [1987] prediction that temporary shocks to purchases should have larger trade balance effects than permanent shocks (however, his prediction was made in the context of a two–good model without capital).

4.3.3 *Suggestions for future empirical work*

One implication that emerges clearly from this work is the necessity to study separately the various fiscal shocks that can lead to fiscal deficits. Further, temporary shocks are predicted to have different effects from highly persistent shocks, with the exception of the effect of spending shocks on the trade and current account balances. Thus the first task for future empirical work is to study the empirical effects of spending vs. tax shocks, and temporary vs. highly persistent shocks. Our results also suggest that the strongest effects may operate at the high–to–medium frequencies, which would mean that a low frequency filter should be applied to the data. An additional advantage of low frequency filtering is that potential problem with nonstationarities are avoided at the outset. This is important, because if asset markets are incomplete, temporary shocks will have permanent effects. Thus even if fiscal shocks are stationary, variables such as consumption, investment, labor input, and output will be nonstationary.

The quantitative theory also contains a rich set of predictions for the way in which the domestic and world economy should respond to fiscal shocks. For example, with trade in financial instruments limited to debt, persistent changes in government purchases or taxes led to minor interest rate effects but strong effects on foreign purchases of debt from domestic residents. Second, and again with limited international trade in financial assets, unexpected permanent increases in government expenditure induced a decline in the foreign stock market and a simultaneous boom

in the domestic market. Future empirical work should investigate whether these predictions are consistent with the data.

5. Summary and Conclusions

This paper has investigated the important channels for the international transmission of fiscal shocks. Our specific concerns were twofold. First, we investigated whether the extent of international linkage through financial markets important for the transmission of fiscal shocks. Second, we explored whether the model predicted a "twin deficits" phenomenon, and as a related matter, we explored whether it was important to distinguish between spending increases and tax cuts as the source of a "deficit shock."

On the first point, we found that the transmission of fiscal shocks was, in most cases, highly sensitive to the assumed structure of international financial markets. In the extreme case of complete risk–pooling, fiscal deficits never lead to any movement in the current account, because complete risk–pooling need not involve any change over time in relative asset holdings. Further, under complete markets the wealth effects associated with fiscal shocks are shared equally across all countries. It remains for future work to undertake a formal statistical evaluation (for example, along the lines recently suggested by King and Watson [1992]) of which asset structure predicts responses most like those we observe in the data. Based on the foregoing considerations, however, it seems likely that the complete markets model would be rejected in favor of a model with restrictions on the menu of tradable assets.

On the second point, we found that the model predicts a fairly robust relationship between fiscal deficits on the one hand, and trade and current account deficits on the other. However, the magnitude of the relationship, as well as the size of interest rate effects and most other macro responses, are highly sensitive both to

the source of the shock (i.e., taxes versus spending) as well as the persistence of the shock. We concluded that prior empirical work has not been able to find robust relationships between fiscal deficits and other variables because these analyses have not appropriately stratified the policy shocks. Finally, we found that the effects of fiscal deficits on interest rates are predicted to be small, except in the case of very short–lived changes in government purchases.

Our analysis has been conducted within a one–good, two country model of a world economy. It is natural to wonder whether our results might not be substantially different if, for example, there were two consumption goods (one produced by each country) as is common in many theoretical trade models. Our view is that this is not likely to be the case, since the one–good model highlights the intertemporal optimization that is central to the determination of interest rates and the saving–investment decision (and the current account is just the difference between saving and investment). Since much of our analysis, and all the empirical work discussed above, focuses on interest rates and current account deficits, the one–good model focuses on exactly the central determinant of these variables. However, the one–good model is not useful for studying the composition of trade, and multi–capital–good extensions of the model could lead to very interesting and much richer dynamic responses. Thus we view the development of multi–good dynamic models of international trade as a very fruitful avenue for future research.

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Table 1

Model Parameterization

Preferences:	
quarterly discount factor:	$\beta = 0.9840$
relative risk aversion:	$\sigma = 2$
steady state hours (fraction of total time):	$\overline{N} = 0.20$
Technology:	
growth rate of labor–augmenting technical change:	$\gamma_X = 1.004$
labor's share:	$\alpha = 0.58$
depreciation rate (quarterly):	$\delta = 0.025$
adjustment cost specification:	
level of adjustment costs:	$\phi(i/k) = i/k$
Tobin's q :	$1/\phi' = 1$
elasticity of (i/k) w.r.t. Tobin's q:	$\eta = 15$
Country size:	
equally–sized countries:	$\pi = 0.50$
Government Policy (steady state values):	
share of gov't purchases in total output:	$s_g = 0.20$
tax rate:	$\tau = 0.30$
transfers:	$TR/Y = 0.10$

TABLE 2-A

Effects of home country government purchases on consumption (goods units)

home country response

	complete markets			incomplete markets		
rho	wealth effect	short run	long run	wealth effect	short run	long run
0.000	-0.0019	-0.0598	0.0000	-0.0029	-0.0613	-0.0011
0.200	-0.0023	-0.0629	0.0000	-0.0036	-0.0648	-0.0014
0.400	-0.0030	-0.0679	0.0000	-0.0048	-0.0703	-0.0019
0.600	-0.0044	-0.0771	0.0000	-0.0070	-0.0807	-0.0028
0.800	-0.0081	-0.0999	0.0000	-0.0133	-0.1069	-0.0054
0.900	-0.0143	-0.1314	0.0000	-0.0240	-0.1447	-0.0102
0.950	-0.0237	-0.1670	0.0000	-0.0412	-0.1908	-0.0184
0.975	-0.0365	-0.1988	0.0000	-0.0657	-0.2387	-0.0307
1.000	-0.0947	-0.2535	-0.0788	-0.1838	-0.3750	-0.1724

foreign country response

	complete markets			incomplete markets		
rho	wealth effect	short run	long run	wealth effect	short run	long run
0.000	-0.0019	-0.0598	0.0000	-0.0008	-0.0584	0.0011
0.200	-0.0023	-0.0629	0.0000	-0.0010	-0.0611	0.0014
0.400	-0.0030	-0.0679	0.0000	-0.0012	-0.0655	0.0019
0.600	-0.0044	-0.0771	0.0000	-0.0018	-0.0735	0.0028
0.800	-0.0081	-0.0999	0.0000	-0.0030	-0.0929	0.0054
0.900	-0.0143	-0.1314	0.0000	-0.0047	-0.1182	0.0102
0.950	-0.0237	-0.1670	0.0000	-0.0063	-0.1432	0.0184
0.975	-0.0365	-0.1988	0.0000	-0.0073	-0.1590	0.0307
1.000	-0.0947	-0.2535	-0.0788	-0.0056	-0.1320	0.0149

TABLE 2-B

Effects of home country government purchases on labor input (%)

home country response

	complete markets			incomplete markets		
rho	wealth effect	short run	long run	wealth effect	short run	long run
0.000	0.0125	0.1505	0.0000	0.0197	0.1542	0.0076
0.200	0.0155	0.1583	0.0000	0.0245	0.1629	0.0095
0.400	0.0203	0.1708	0.0000	0.0323	0.1769	0.0126
0.600	0.0296	0.1939	0.0000	0.0474	0.2029	0.0187
0.800	0.0548	0.2513	0.0000	0.0894	0.2688	0.0363
0.900	0.0967	0.3307	0.0000	0.1620	0.3639	0.0686
0.950	0.1601	0.4201	0.0000	0.2778	0.4801	0.1238
0.975	0.2462	0.5002	0.0000	0.4431	0.6005	0.2070
1.000	0.6384	0.6378	0.5310	1.2389	0.9435	1.1621

foreign country response

	complete markets			incomplete markets		
rho	wealth effect	short run	long run	wealth effect	short run	long run
0.000	0.0125	0.1505	0.0000	0.0052	0.1468	-0.0076
0.200	0.0155	0.1583	0.0000	0.0064	0.1537	-0.0095
0.400	0.0203	0.1708	0.0000	0.0083	0.1647	-0.0126
0.600	0.0296	0.1939	0.0000	0.0118	0.1848	-0.0187
0.800	0.0548	0.2513	0.0000	0.0203	0.2337	-0.0363
0.900	0.0967	0.3307	0.0000	0.0314	0.2974	-0.0686
0.950	0.1601	0.4201	0.0000	0.0423	0.3601	-0.1238
0.975	0.2462	0.5002	0.0000	0.0493	0.4000	-0.2070
1.000	0.6384	0.6378	0.5310	0.0379	0.3321	-0.1001

TABLE 3-A

Effects of home country tax cut on consumption (goods units)

home country response

	complete markets			incomplete markets		
rho	wealth effect	short run	long run	wealth effect	short run	long run
0.000	-0.0001	0.0607	0.0000	0.0002	0.0610	0.0003
0.200	-0.0001	0.0605	0.0000	0.0003	0.0610	0.0004
0.400	-0.0001	0.0602	0.0000	0.0004	0.0609	0.0006
0.600	-0.0003	0.0596	0.0000	0.0006	0.0609	0.0010
0.800	-0.0009	0.0582	0.0000	0.0014	0.0614	0.0024
0.900	-0.0025	0.0563	0.0000	0.0032	0.0642	0.0060
0.950	-0.0062	0.0542	0.0000	0.0069	0.0720	0.0137
0.975	-0.0126	0.0523	0.0000	0.0130	0.0873	0.0270
1.000	-0.0499	0.0490	0.2774	0.0475	0.1817	0.3797

foreign country response

	complete markets			incomplete markets		
rho	wealth effect	short run	long run	wealth effect	short run	long run
0.000	0.0005	0.0156	0.0000	0.0002	0.0152	-0.0003
0.200	0.0006	0.0154	0.0000	0.0002	0.0149	-0.0004
0.400	0.0008	0.0151	0.0000	0.0003	0.0143	-0.0006
0.600	0.0013	0.0145	0.0000	0.0004	0.0133	-0.0010
0.800	0.0030	0.0131	0.0000	0.0007	0.0100	-0.0024
0.900	0.0066	0.0112	0.0000	0.0008	0.0034	-0.0260
0.950	0.0138	0.0091	0.0000	0.0007	-0.0087	-0.0137
0.975	0.0257	0.0072	0.0000	0.0001	-0.0278	-0.0270
1.000	0.0918	0.0039	0.1168	-0.0055	-0.1289	0.0145

TABLE 3-B

Effects of home country tax cut on labor input (%)

home country response

	complete markets			incomplete markets		
rho	wealth effect	short run	long run	wealth effect	short run	long run
0.000	0.0004	0.4871	0.0000	-0.0015	0.4861	-0.0020
0.200	0.0006	0.4875	0.0000	-0.0019	0.4863	-0.0026
0.400	0.0010	0.4883	0.0000	-0.0026	0.4865	-0.0038
0.600	0.0019	0.4897	0.0000	-0.0042	0.4866	-0.0064
0.800	0.0060	0.4932	0.0000	-0.0096	0.4852	-0.0163
0.900	0.0170	0.4980	0.0000	-0.0218	0.4782	-0.0407
0.950	0.0415	0.5034	0.0000	-0.0464	0.4586	-0.0924
0.975	0.0850	0.5082	0.0000	-0.0880	0.4201	-0.1818
1.000	0.3363	0.5165	1.0857	-0.3199	0.1825	0.3960

foreign country response

	complete markets			incomplete markets		
rho	wealth effect	short run	long run	wealth effect	short run	long run
0.000	-0.0032	-0.0391	0.0000	-0.0014	-0.0382	0.0020
0.200	-0.0041	-0.0387	0.0000	-0.0017	-0.0374	0.0026
0.400	-0.0057	-0.0379	0.0000	-0.0021	-0.0361	0.0038
0.600	-0.0090	-0.0365	0.0000	-0.0029	-0.0334	0.0064
0.800	-0.0201	-0.0331	0.0000	-0.0045	-0.0251	0.0163
0.900	-0.0444	-0.0283	0.0000	-0.0057	-0.0086	0.0407
0.950	-0.0928	-0.0229	0.0000	-0.0048	0.0219	0.0924
0.975	-0.1733	-0.0180	0.0000	-0.0003	0.0701	0.1818
1.000	-0.6192	-0.0097	-0.7875	0.0371	0.3244	-0.0978

TABLE 4

A. Impact effect of increase in gov't purchases (goods units)

rhog	fiscal deficit	trade deficit	CA deficit	interest rate*	HC cons'n.	HC inv.
0.000	0.97	0.50	0.51	47.5	-0.06	-0.35
0.200	0.97	0.50	0.51	38.0	-0.06	-0.34
0.400	0.97	0.50	0.51	28.5	-0.07	-0.33
0.600	0.96	0.50	0.51	19.2	-0.08	-0.30
0.800	0.95	0.50	0.51	10.2	-0.11	-0.24
0.900	0.94	0.50	0.50	6.3	-0.14	-0.15
0.950	0.92	0.50	0.50	5.0	-0.19	-0.03
0.975	0.90	0.49	0.50	4.7	-0.24	0.08
1.000	0.84	0.48	0.49	5.1	-0.38	0.41

B. Impact effect of decrease in tax rate (goods units)

rhot	fiscal deficit	trade deficit	CA deficit	interest rate*	HC cons'n.	HC inv.
0.000	0.92	-0.13	-0.13	-12.4	0.06	0.09
0.200	0.92	-0.12	-0.12	- 9.0	0.06	0.10
0.400	0.92	-0.10	-0.10	- 5.5	0.06	0.12
0.600	0.92	-0.07	-0.07	- 2.1	0.06	0.15
0.800	0.92	0.00	0.00	1.3	0.06	0.22
0.900	0.92	0.10	0.11	3.1	0.06	0.32
0.950	0.92	0.21	0.22	4.0	0.07	0.41
0.975	0.93	0.31	0.31	4.5	0.09	0.47
1.000	0.97	0.47	0.48	5.0	0.18	0.40

* annualized basis points.

FIGURE 1: THE TWIN DEFICITS

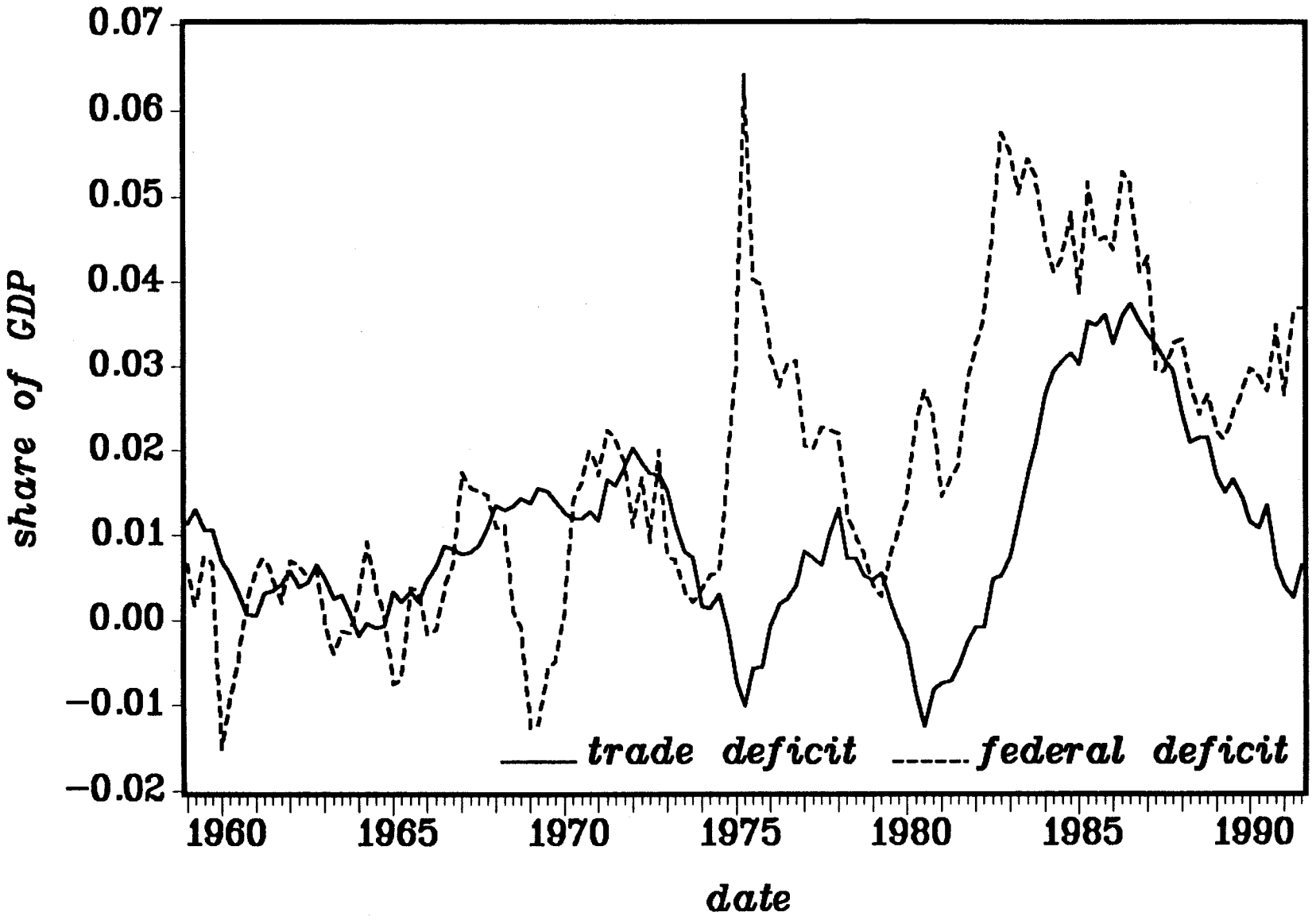
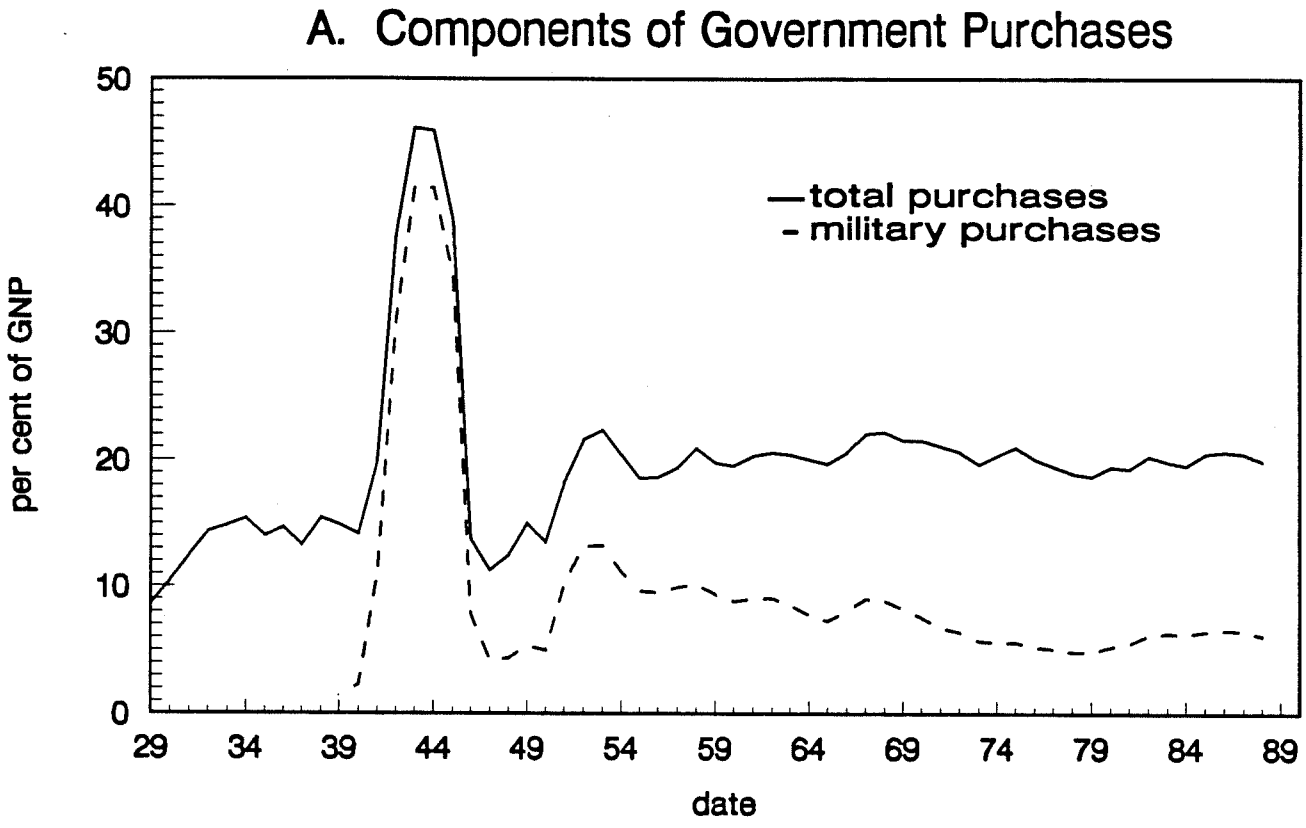


Figure 2: Government spending and tax rates in the US



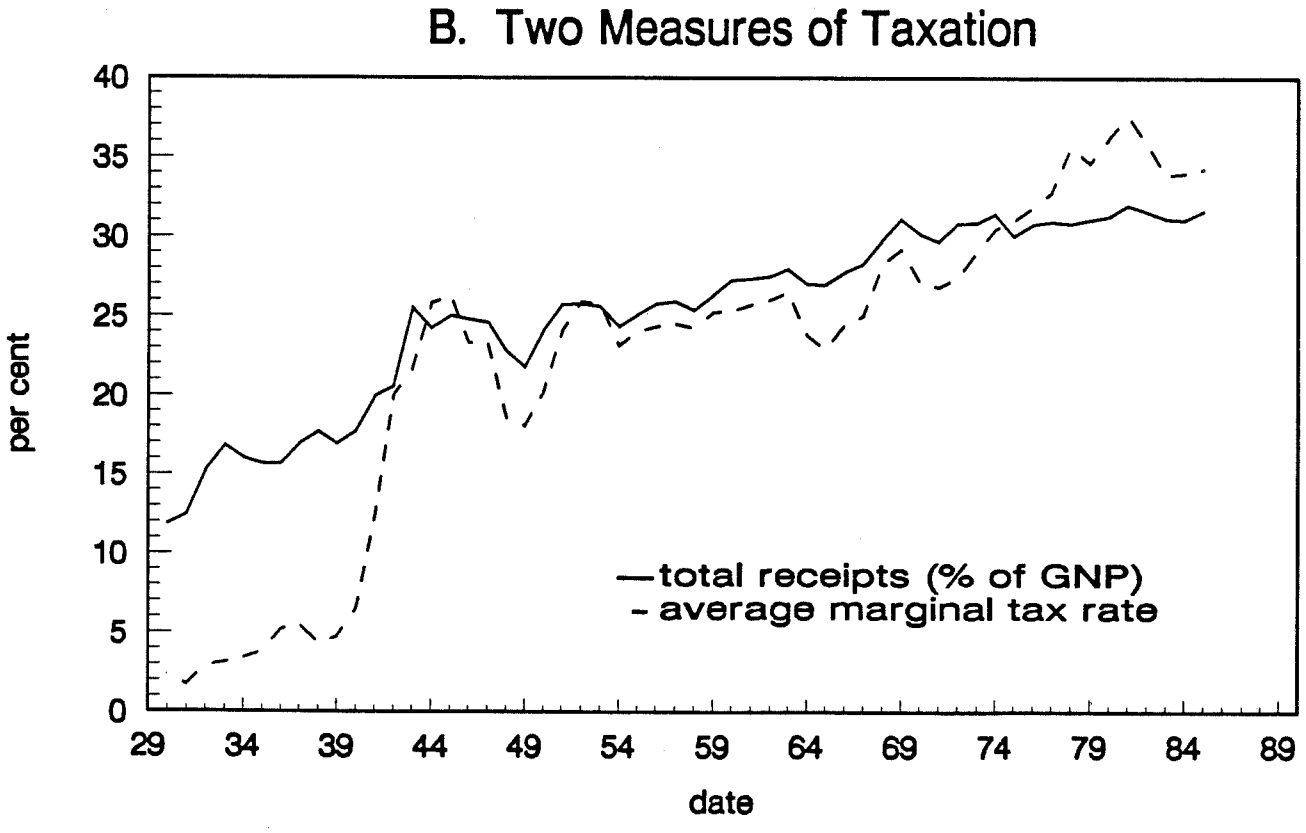


Fig. 3: Permanent increase in HC government purchases

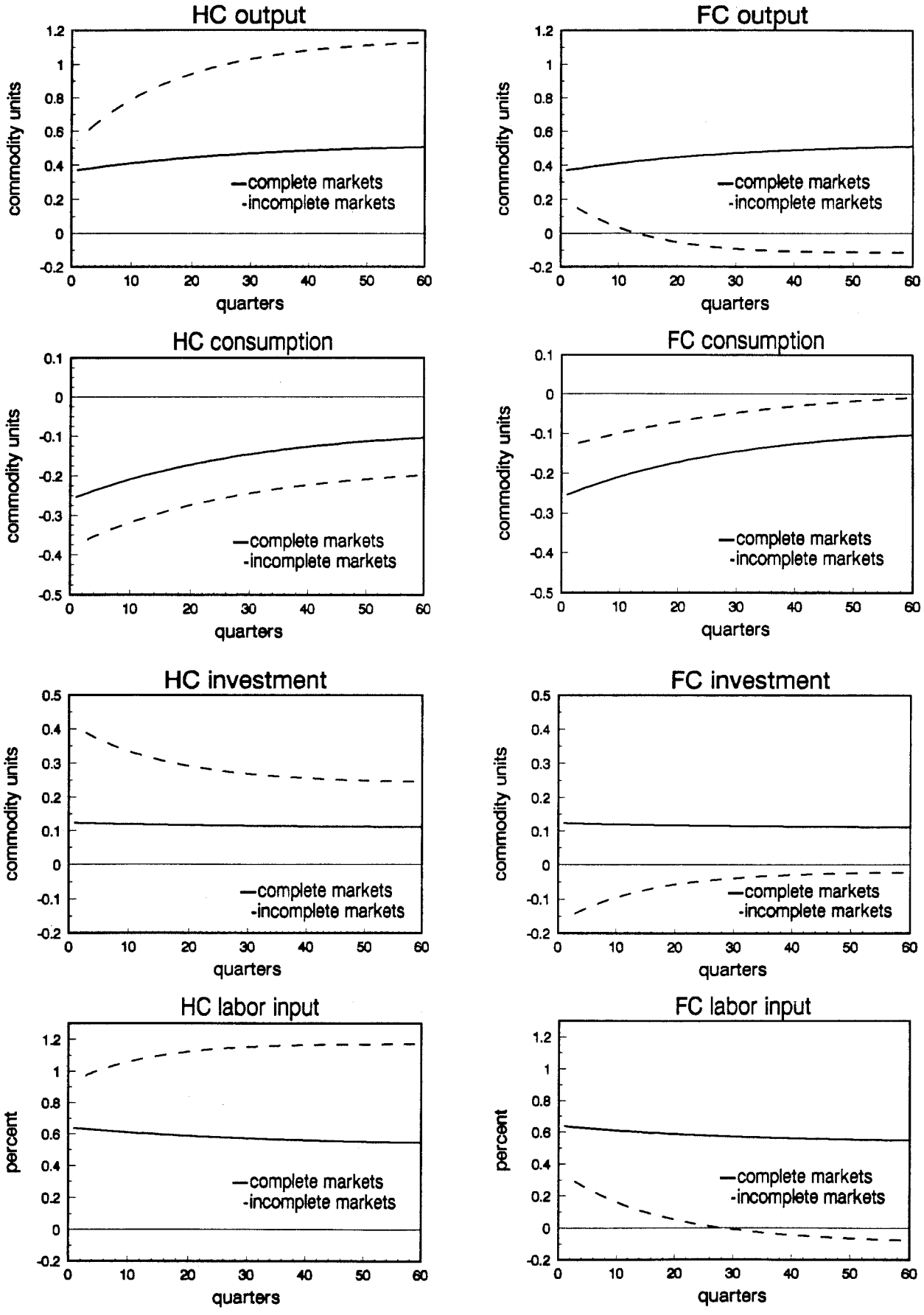


Fig. 3, cont'd.

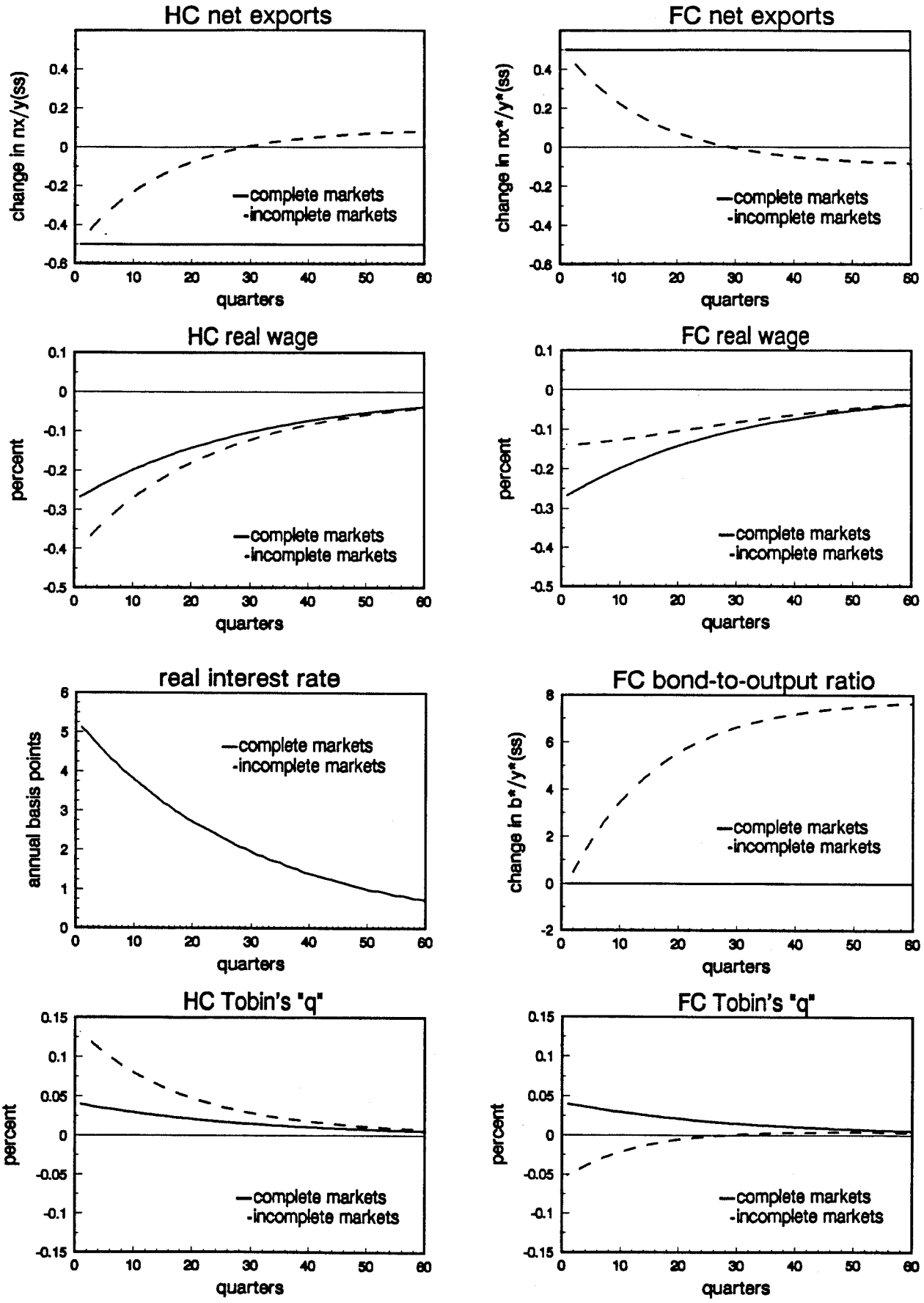

HC net exports
change in nx/y(ss)
quarters
—complete markets
-incomplete markets
FC net exports
change in nx*/y*(ss)
quarters
—complete markets
-incomplete markets
HC real wage
percent
quarters
—complete markets
-incomplete markets
FC real wage
percent
quarters
—complete markets
-incomplete markets
real interest rate
annual basis points
quarters
—complete markets
-incomplete markets
FC bond-to-output ratio
change in b*/y*(ss)
quarters
—complete markets
-incomplete markets
HC Tobin's "q"
percent
quarters
—complete markets
-incomplete markets
FC Tobin's "q"
percent
quarters
—complete markets
-incomplete markets

Fig. 4: Permanent decrease in HC tax rate

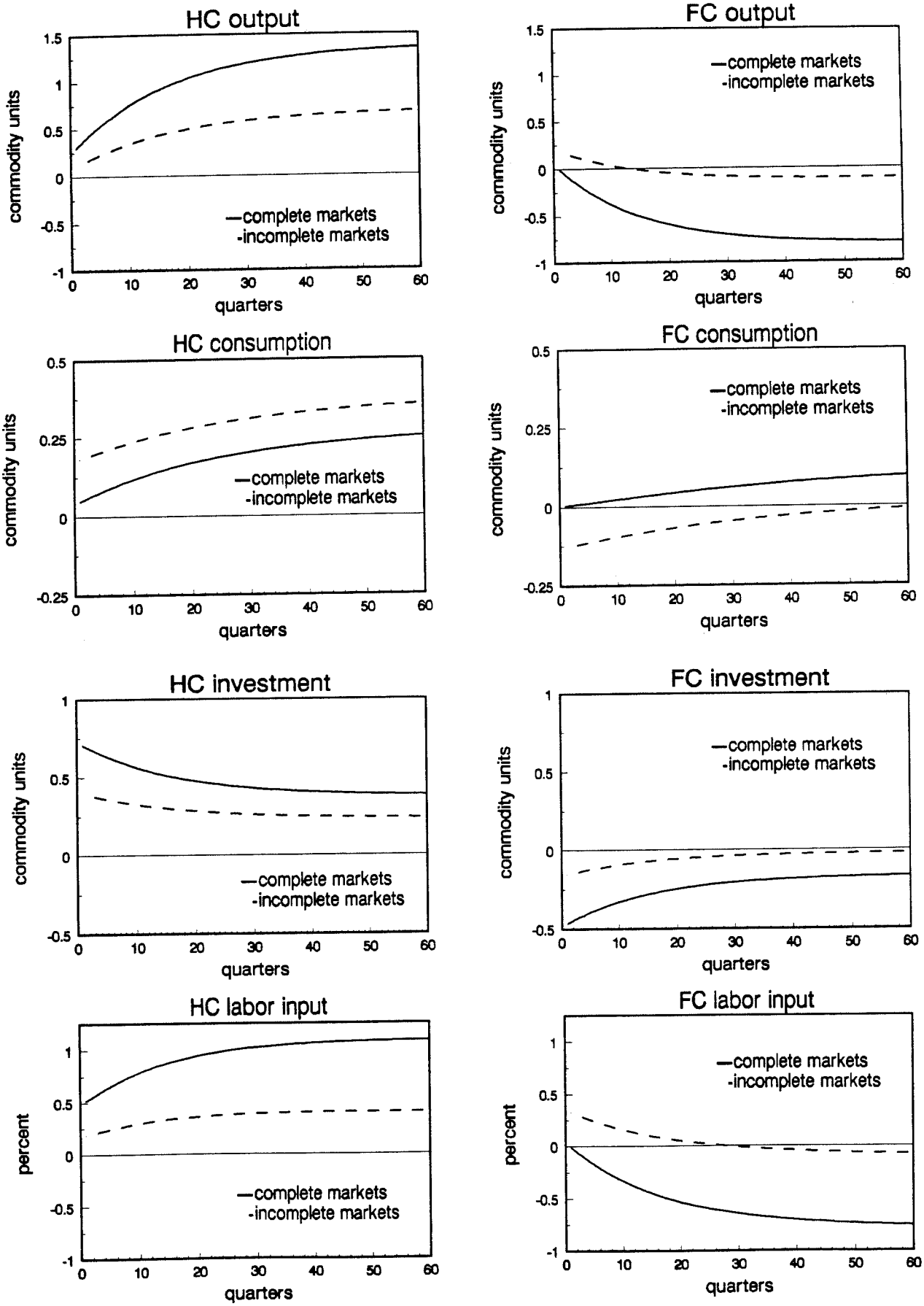
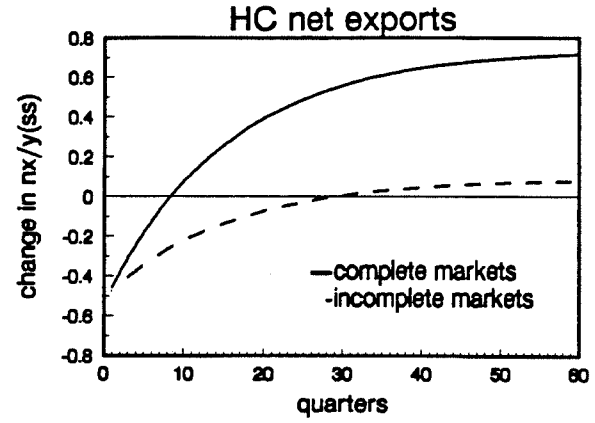
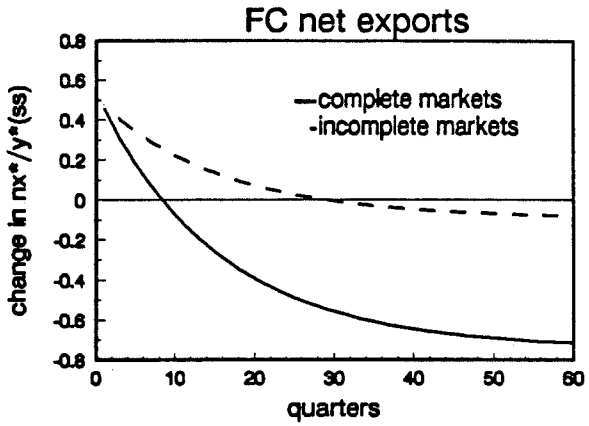
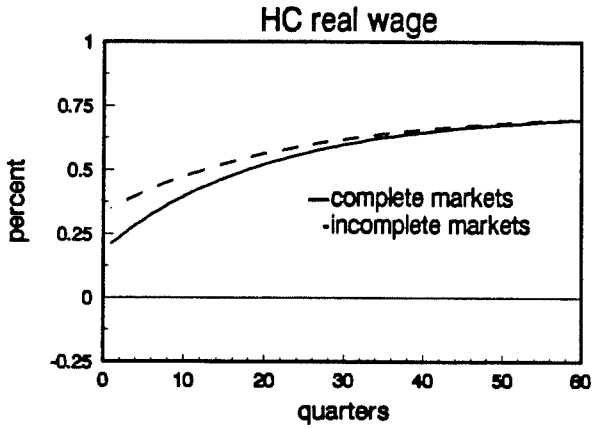
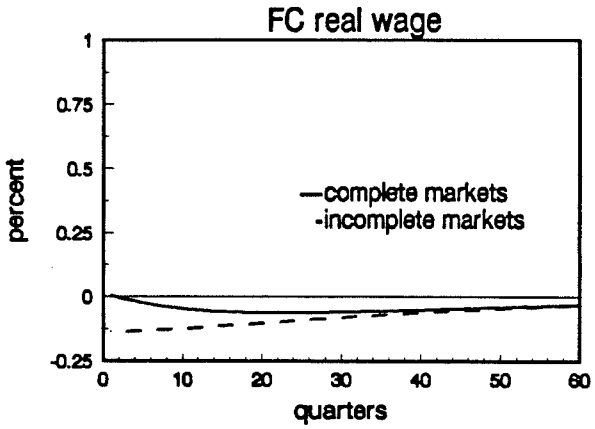


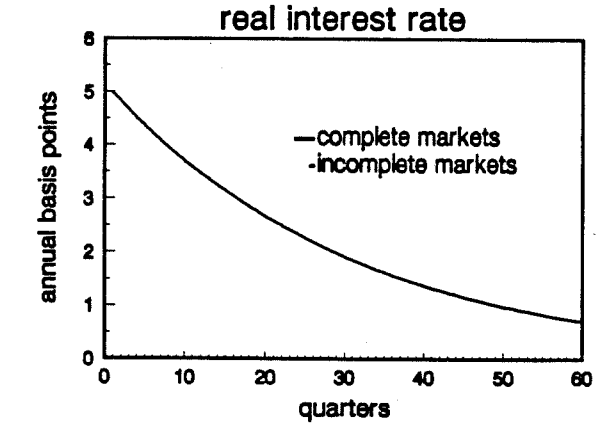
Fig. 4, cont'd.

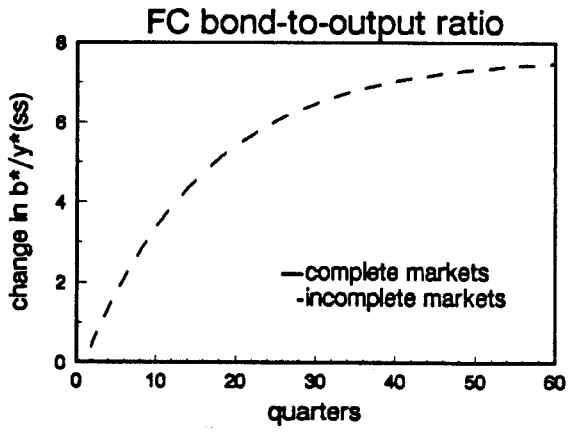

HC net exports
change in nx/y(ss)
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets

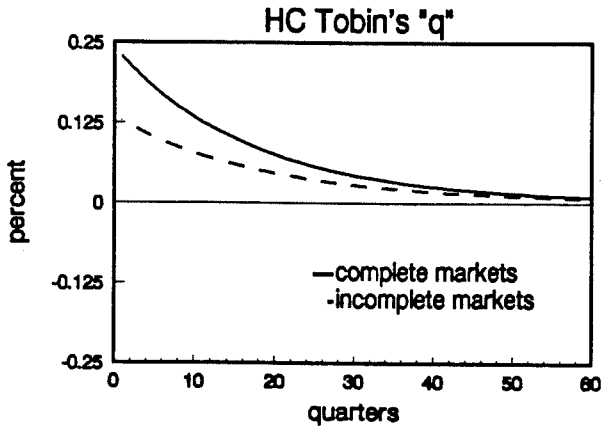

FC net exports
change in nx*/y*(ss)
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets


HC real wage
percent
1
0.75
0.5
0.25
0
-0.25
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets


FC real wage
percent
1
0.75
0.5
0.25
0
-0.25
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets


real interest rate
annual basis points
6
5
4
3
2
1
0
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets


FC bond-to-output ratio
change in b*/y*(ss)
8
6
4
2
0
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets


HC Tobin's "q"
percent
0.25
0.125
0
-0.125
-0.25
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets

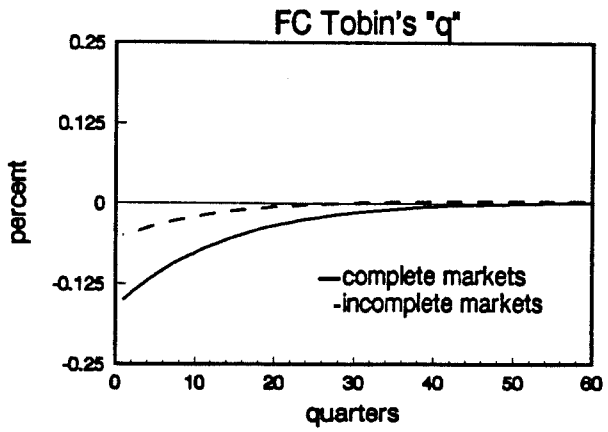

FC Tobin's "q"
percent
0.25
0.125
0
-0.125
-0.25
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets

Fig. 5: Temporary increase in HC government purchases

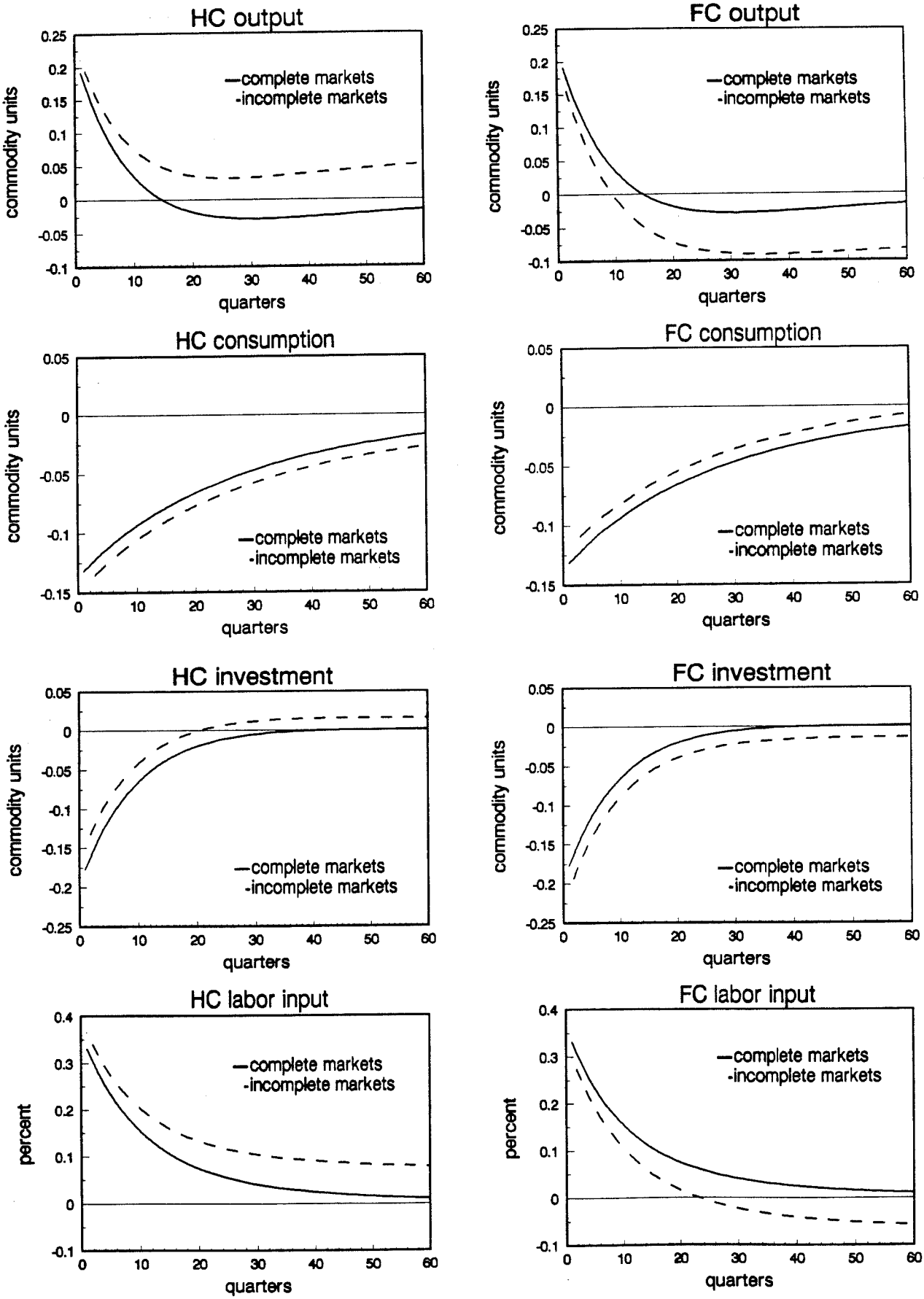
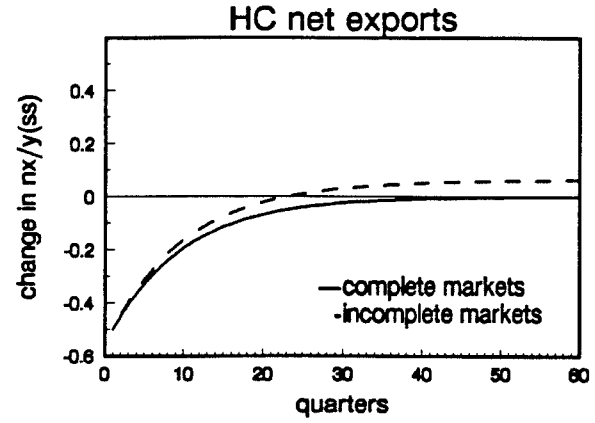
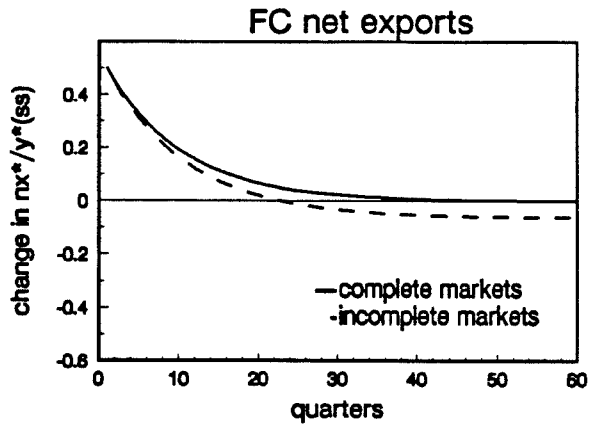
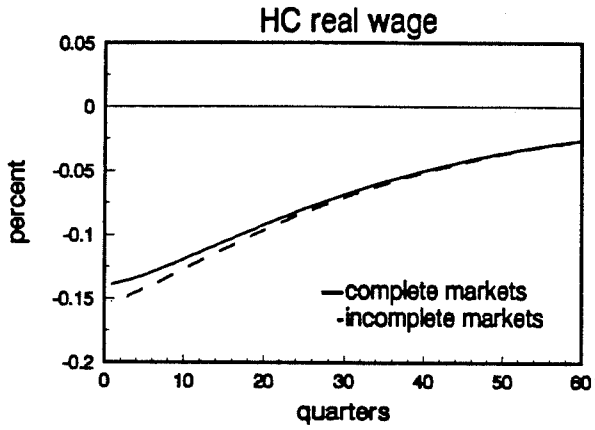
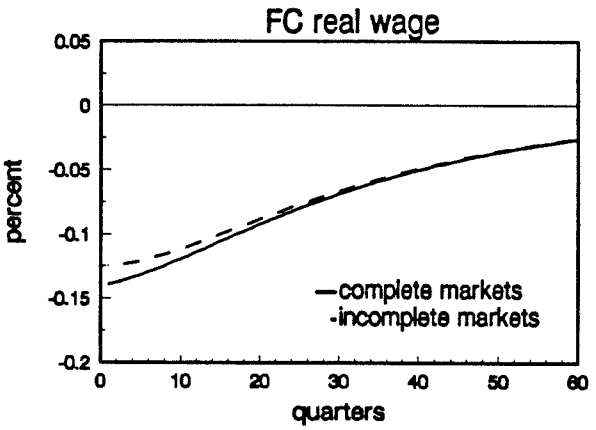


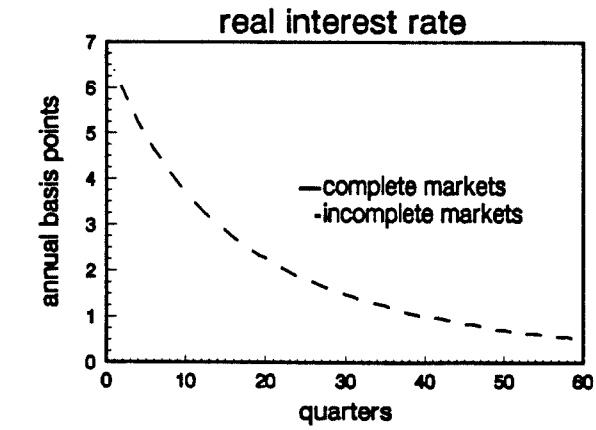
Fig. 5, cont'd.

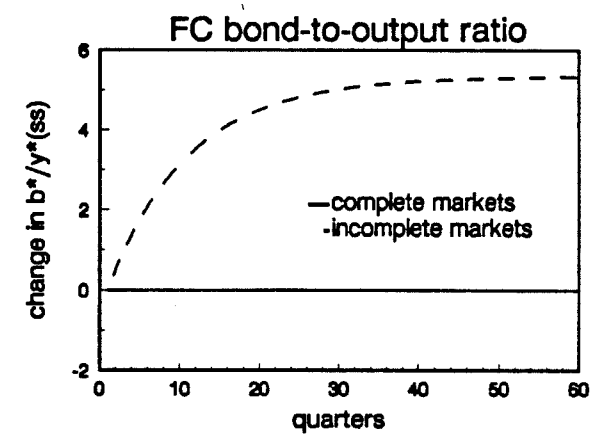

HC net exports
change in nx/y(ss)
0.4
0.2
0
-0.2
-0.4
-0.6
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets

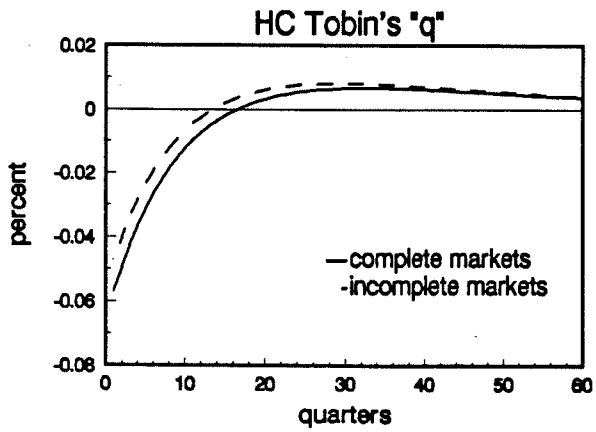

FC net exports
change in nx*/y*(ss)
0.4
0.2
0
-0.2
-0.4
-0.6
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets


HC real wage
percent
0.05
0
-0.05
-0.1
-0.15
-0.2
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets


FC real wage
percent
0.05
0
-0.05
-0.1
-0.15
-0.2
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets


real interest rate
annual basis points
7
6
5
4
3
2
1
0
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets


FC bond-to-output ratio
change in b*/y*(ss)
6
4
2
0
-2
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets


HC Tobin's "q"
percent
0.02
0
-0.02
-0.04
-0.06
-0.08
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets

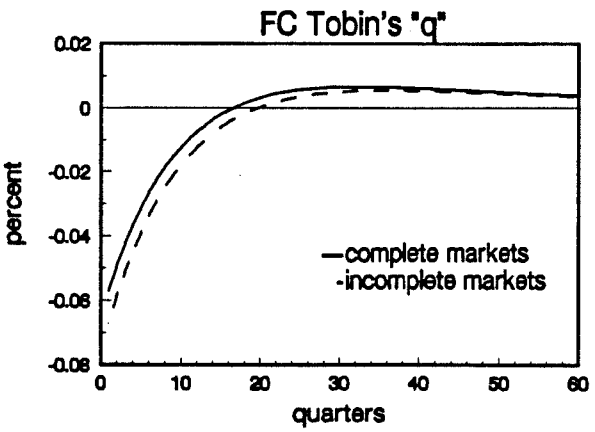

FC Tobin's "q"
percent
0.02
0
-0.02
-0.04
-0.06
-0.08
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets

Fig. 6: Temporary decrease in HC tax rate

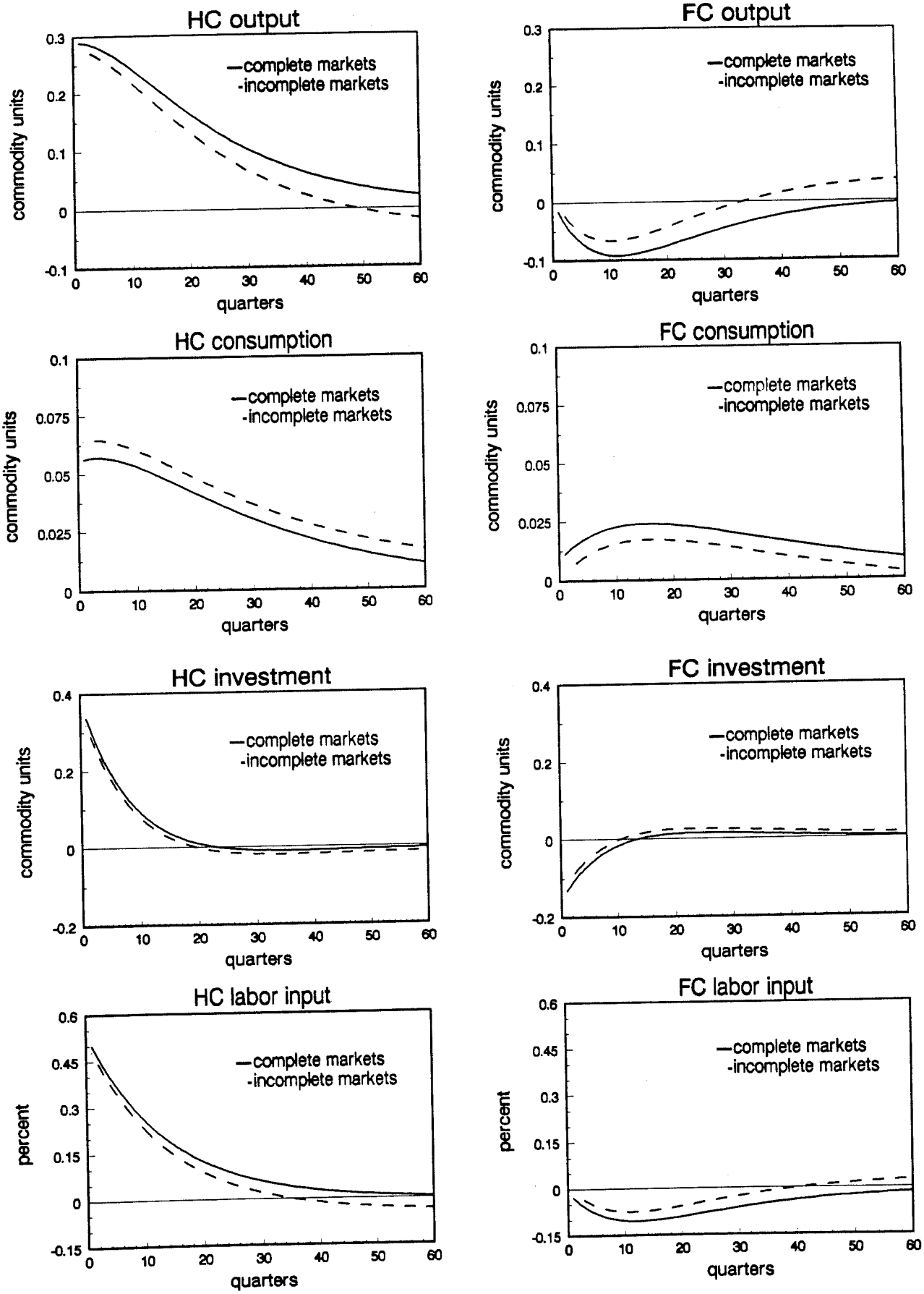
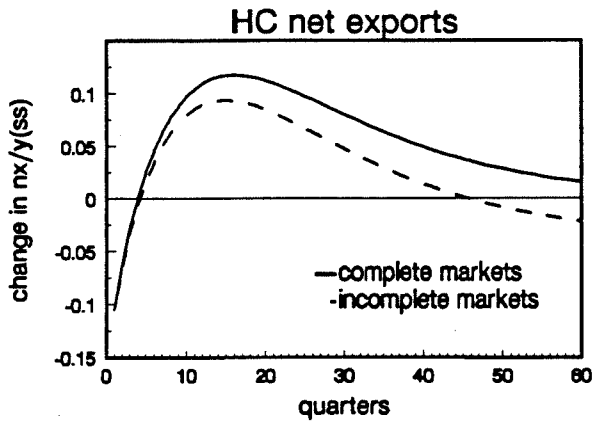
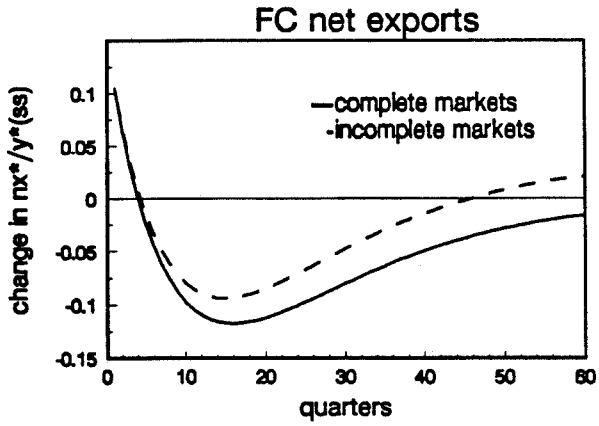
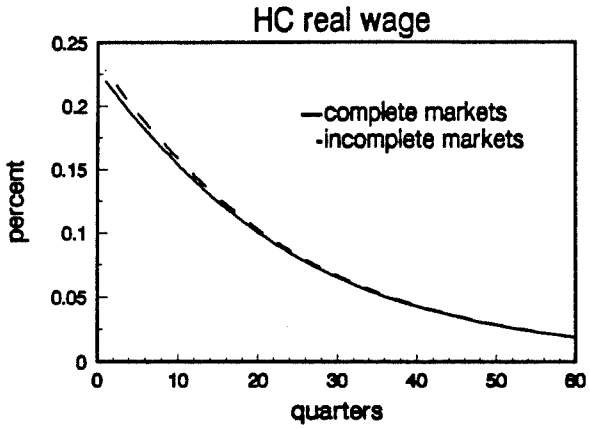
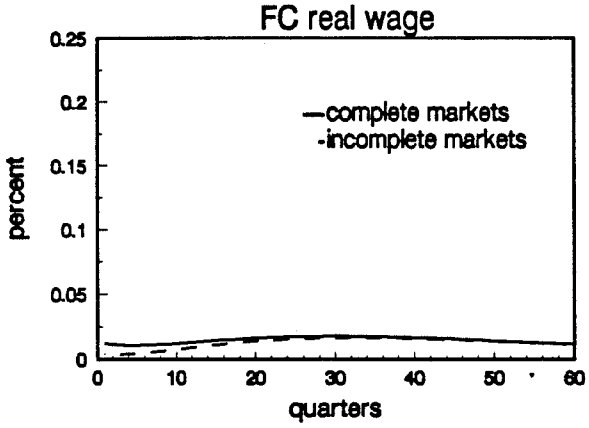


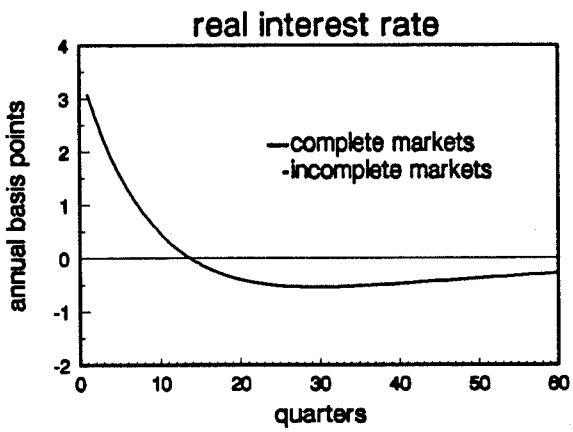
Fig. 6, cont'd.

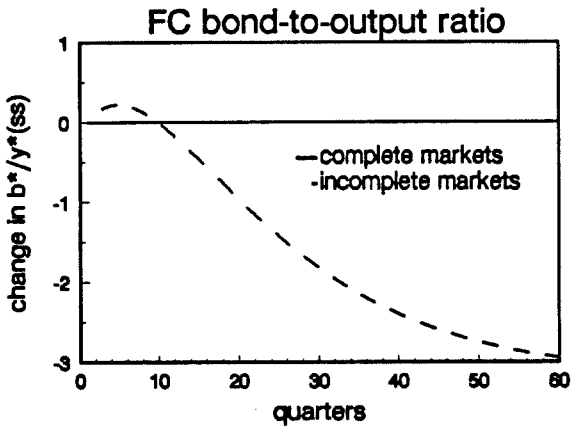

HC net exports
change in nx/y(ss)
0.1
0.05
0
-0.05
-0.1
-0.15
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets

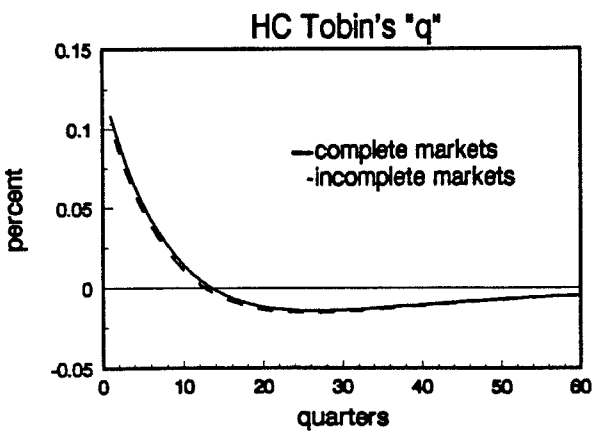

FC net exports
change in nx*/y*(ss)
0.1
0.05
0
-0.05
-0.1
-0.15
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets


HC real wage
percent
0.25
0.2
0.15
0.1
0.05
0
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets


FC real wage
percent
0.25
0.2
0.15
0.1
0.05
0
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets


real interest rate
annual basis points
4
3
2
1
0
-1
-2
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets


FC bond-to-output ratio
change in b*/y*(ss)
1
0
-1
-2
-3
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets


HC Tobin's "q"
percent
0.15
0.1
0.05
0
-0.05
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets

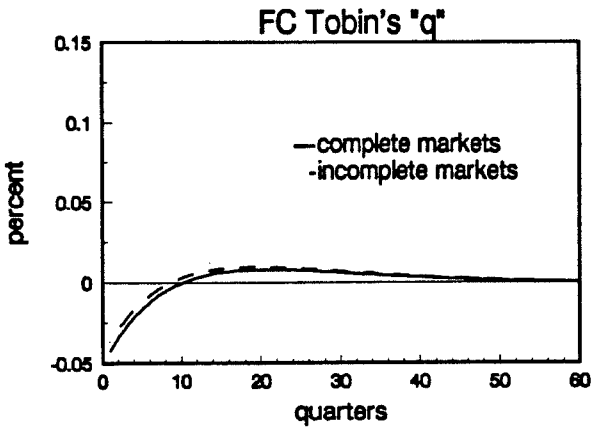
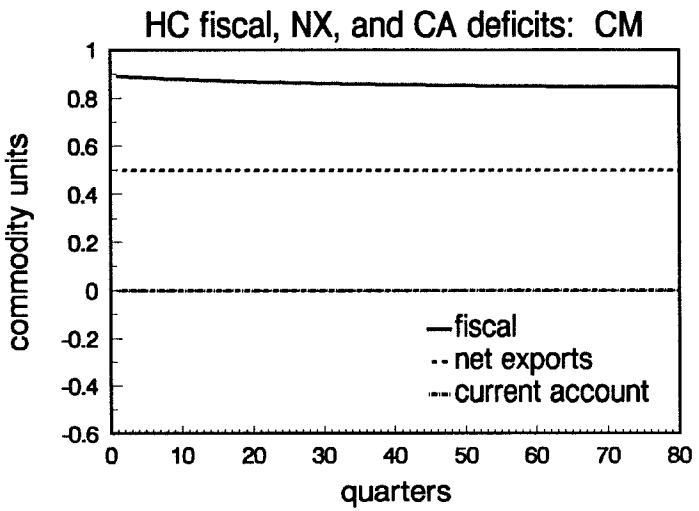
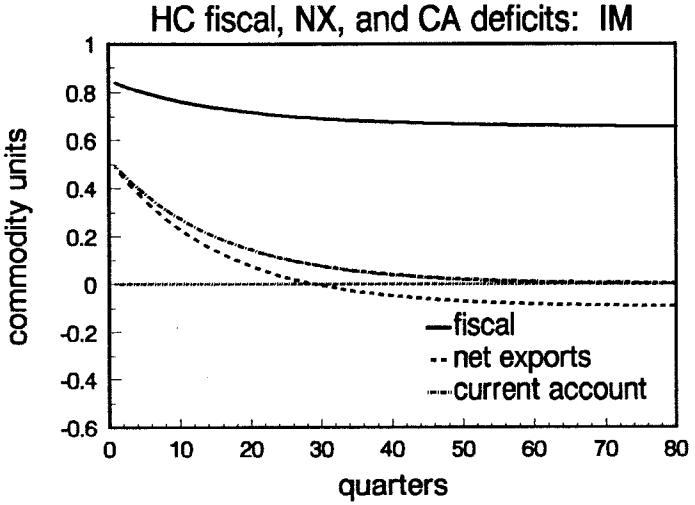
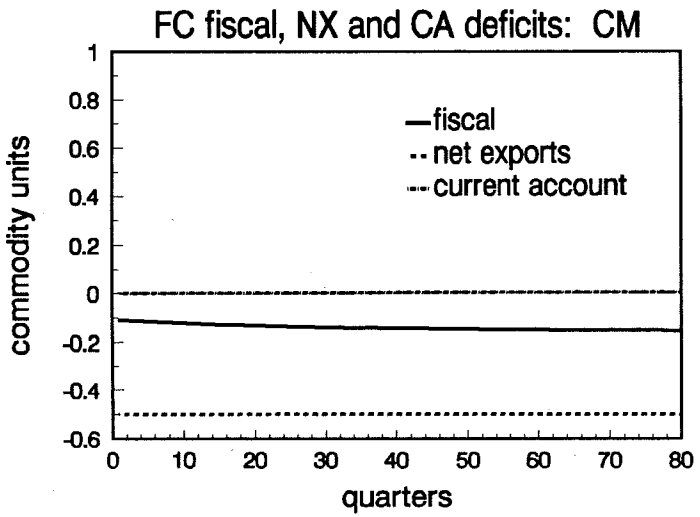

FC Tobin's "q"
percent
0.15
0.1
0.05
0
-0.05
0
10
20
30
40
50
60
quarters
—complete markets
-incomplete markets

Fig. 7-A: Permanent increase in HC government purchases







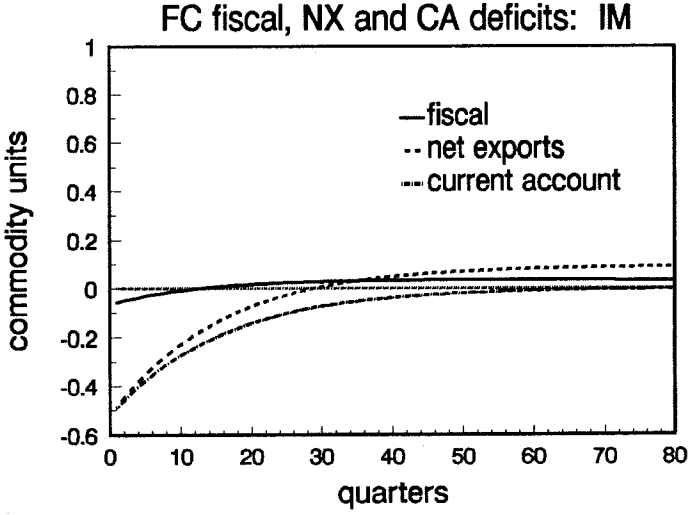
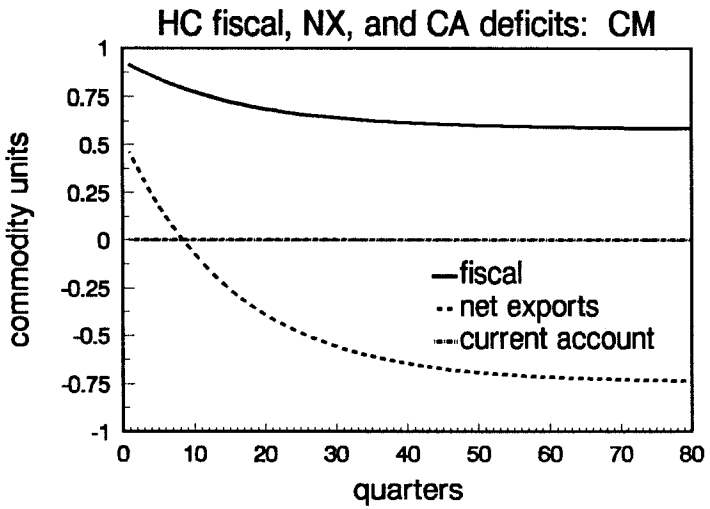
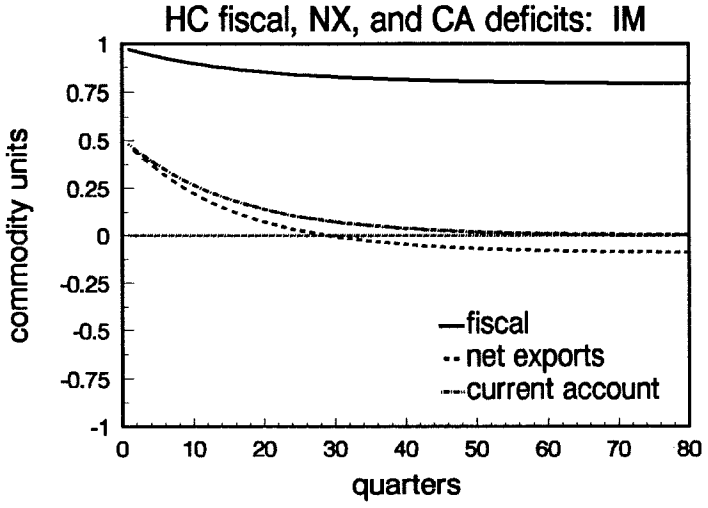
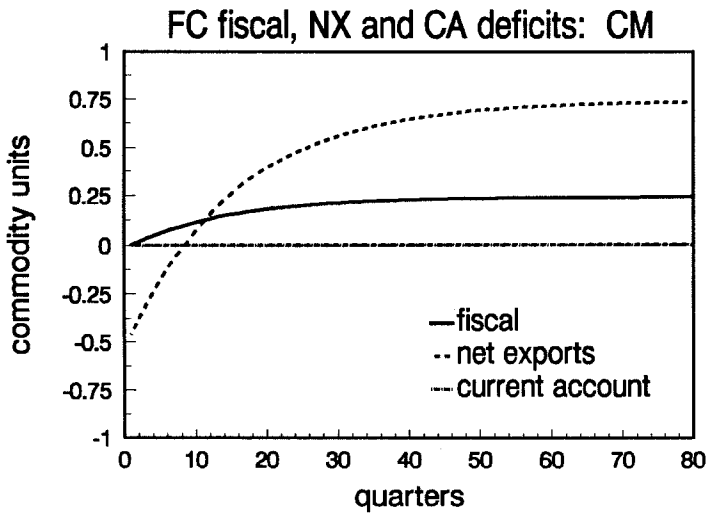


Fig. 7-B: Permanent decrease in HC tax rate







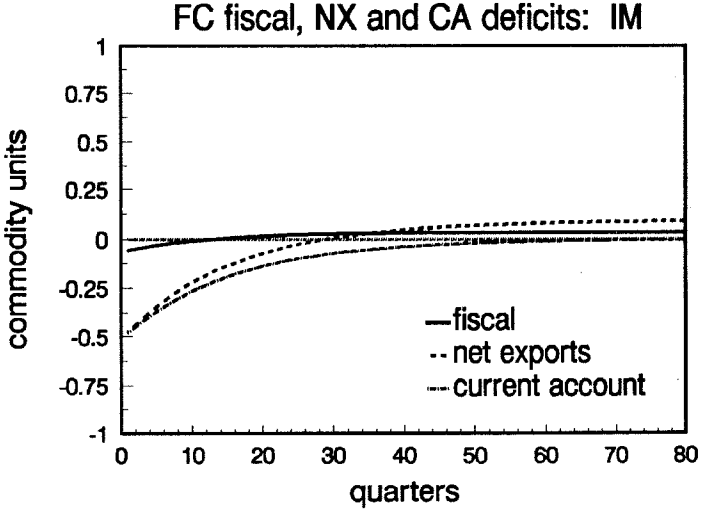
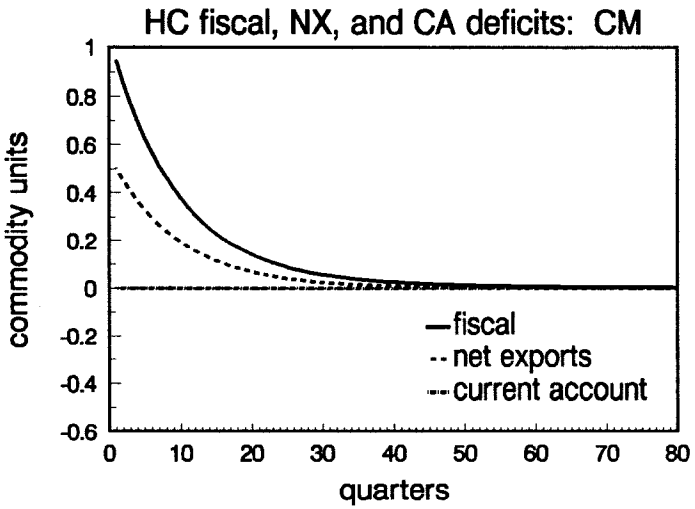
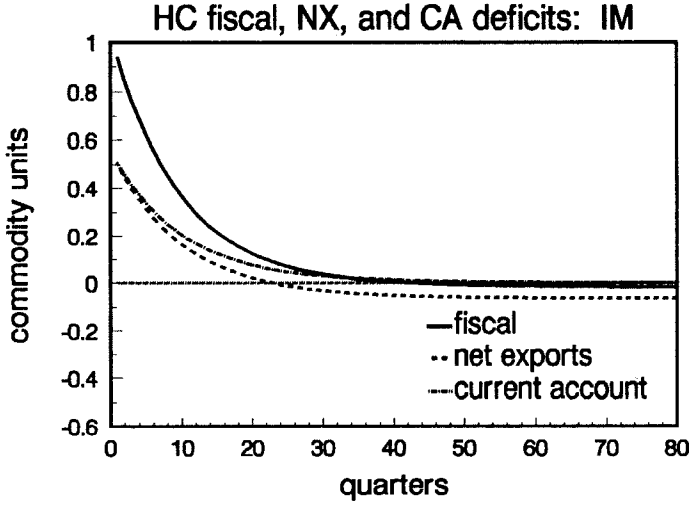
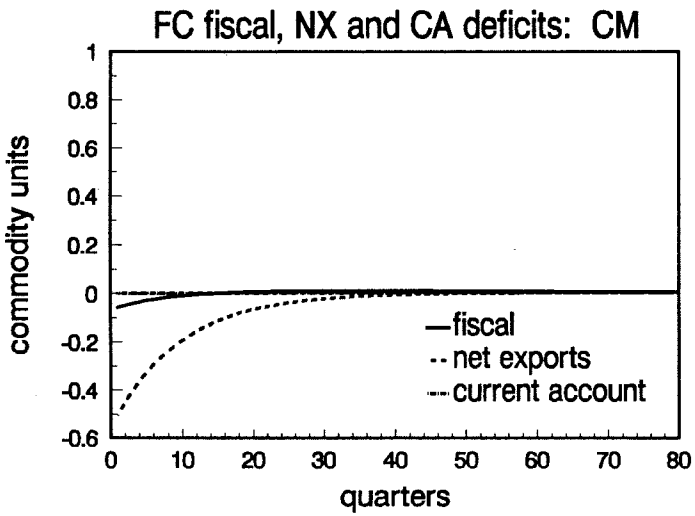


Fig. 7-C: Temporary increase in HC government purchases (rhog = 0.90)







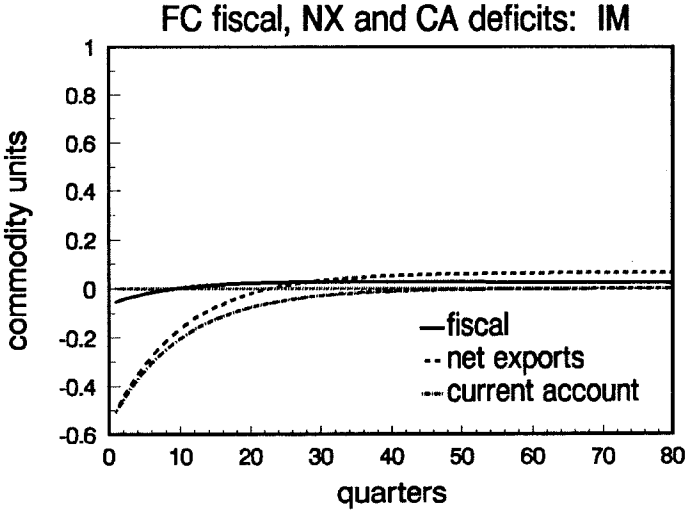


Fig. 7-D: Temporary decrease in HC tax rate

(rhot = 0.90)