Relative Prices and Tax Policies: Some Preliminary Implications and Results

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Relative Prices and Tax Policies: Some Preliminary Implications and Results

by Karl Brunner and Allan H. Meltzer */

One of De Viti de Marco's lasting contributions to economic theory is his demonstration that the effects of alternative taxes on relative prices can be analyzed as a reallocation of demand. His analysis of tax shifting starts by changing the resources available to the consumer -- changing the budget constraint -- while holding the supply schedules of taxed and untaxed commodities unchanged. Shifts in demand force a reallocation of resources, changing producers' marginal cost, prices and the composition of output.

The emphasis placed on the reallocation of demand suggests an extension of the framework to analyze, at the macro level, some neglected aspects of alternative tax policies. In this paper, we develop a model that yields a proposition about the short-term effects of tax changes on the composition of expenditure, output and relative prices and use the analysis to discuss two issues: the size and variability of the economy's response to changes in fiscal policy and the effect of border tax adjustments.

Several studies have shown that the estimated size of the fiscal policy multiplier, obtained from single equation regressions, varies considerably from period to period. The estimated multiplier is higher in periods of

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deep depression than in periods of mild recession or prosperity, and frequently the multiplier is less than unity. These facts warrant more attention than they have received, particularly where fiscal policy is used as a main or important instrument of macro-economic policy. Below we show that both the variability of the multiplier and its relatively small value in periods of prosperity can be explained by our model.

Under the General Agreement on Tariffs and Trade (GATT) countries are permitted to rebate indirect taxes, such as sales excise and turnover taxes, but not direct taxes, paid by processors on goods exported. Indirect taxes can be collected on imports as they move through stages of processing to final sale in the importing country. The procedure for rebating taxes on exports and assessing taxes on imports is known as border tax adjustment.

A common view among businessmen and some economists is that a country can increase exports relative to imports and reduce a balance of payments deficit by replacing direct taxes with indirect taxes. According to this argument, rebating indirect taxes at the border reduces the market price of exports and increases the amount exported; taxing imports at the border raises the market price of imports and reduces the amount imported. This view is now well enough established to have furnished the basis for public policy in West Germany where border tax adjustments were partially reduced.

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in 1968-69 in lieu of currency revaluation. The expected effect of the policy action was that Germany's export prices would rise relative to the prices in competing countries thereby reducing Germany's export surplus.

In the usual analysis of tax shifting, prices are free to adjust. The standard argument for border tax adjustment, on the other hand keeps exchange rates unchanged by assumption. Indeed, the posited effect of border tax adjustment on a country's balance of payments depends on the change in export prices relative to the prices of imports and domestically produced goods where exchange rates are fixed and longer-run changes in the stock of capital and in the capital-labor ratio are neglected. The longer-run effects depend on the means chosen to correct the balance of payments disequilibrium and the incidence of direct and indirect taxes in the various countries.

The size of the short-run effects of tax changes and border tax adjustments depend, of course, on the price elasticities of the demand and supply functions for the goods (including exports and imports) produced or purchased in the several countries. Standard discussion of fiscal policy and discussions of border tax adjustment ignores these elasticities and suggests that the elasticities always work to increase the surplus (or reduce the deficit) of countries that rely most on indirect, rebatable taxes. Where price elasticities for the same commodities differ between countries, there can be little certainty about the size or direction of the short-term effect. In the following section, we introduce a model of a system with direct and indirect taxes and analyze some effects on relative prices of changes in the composition of taxes. Then we present some parameter estimates and discuss some implications of the model and the evidence. Throughout, we maintain a short-term focus, ignoring the longer-term effects
of monetary and fiscal policies on the price level, stocks of capital and payments imbalances of the various countries.

A Two Tax System

To analyze the short-run effects on relative prices of changes in the composition of taxes and border tax adjustment, we introduce a second commodity into the standard income-expenditure model. In each country, there are real expenditure functions for two commodities, and both types of expenditures depend on the relative price and the composition of taxes. All government and private purchases are included in expenditure. However, we assume that changes in the amount of government expenditure, the stock of money, and the deficit or surplus in the balance of payments and the government budget do not affect the price ratios. The effect of these variables on economic activity appears through changes in the real wage, taken as a given in our model. 2/

Let \( r^e \) be the amount of real expenditure on \( r \) by domestic purchasers and \( s^e \) be the real expenditure on \( s \) by domestic and foreign purchasers. Commodity \( r \) is imported but not exported; \( s \) may be exported but not imported. Let \( p_r/p_s \) be the price ratio for the two composite commodities and \( y-T \) be aggregate real income net of direct taxes. If indirect taxes -- sales or turnover taxes -- are assessed equally against all commodities, market prices rise or fall in proportion and the price ratio is unaffected. Border tax adjustments, however, remove indirect taxes from the portion of commodity \( s \) sold abroad. Let \( q \) be the proportional increase in the relative price of domestic purchases resulting

\[ q = \frac{1}{p_r/p_s} \]

2/ A more general analysis of fiscal policy -- tax rates and expenditures -- incorporating the effects on credit, output and labor markets must await the more detailed analysis of a later paper.
from indirect taxes and border tax adjustments. The real expenditure
functions for \( r \) and \( s \) are \(^3/\)

\[
(1) \quad r^e = a_{11} \frac{p_r}{p_s} q + a_{12} (y-T) \quad a_{11} < 0 \quad a_{12} > 0
\]

\[
(2) \quad s^e = a_{21} \frac{p_r}{p_s} q + a_{22} (y-T) \quad a_{21} > 0 \quad a_{22} > 0
\]

The amounts of \( r \) and \( s \) produced depends on the relative price and the real wage, \( w \).

\[
(3) \quad r = a_{31} \frac{p_r}{p_s} + a_{32} w \quad a_{31} > 0 \quad a_{32} < 0
\]

\[
(4) \quad s = a_{41} \frac{p_r}{p_s} + a_{42} w \quad a_{41} < 0 \quad a_{42} < 0
\]

Total real direct taxes depend on output, \( y \).

\[
(5) \quad T = ty \quad t > 0
\]

Three equations close the system. Equations (6) and (7) define total real output \( y \) as the sum of \( r \) and \( s \) supplied and aggregate real expenditure \( A \) as the sum of \( r^e \) and \( s^e \); the equilibrium condition (8) requires that the \( A \) and \( y \) are equal in equilibrium

\[
(6) \quad y = r + s
\]

\[
(7) \quad A = r^e + s^e
\]

\[
(8) \quad A = y
\]

\(^3/\) The expenditure equations make the expenditure of foreign purchasers depend on the relative prices in the exporting country, in effect taking a subset of the prices of exported goods as numeraire. International differences in prices affect expenditures by changing the composition of exports and imports and thus changing \( p_r/p_s \). We ignore changes in relative income. The larger the proportion of \( s \) exported, the smaller is \( a_{22} \).
The eight equations determine the relative price \( \frac{p_r}{p_s} \), expenditures and output of \( r \) and \( s \) and total tax collections, given the marginal direct tax rate, \( t \), the indirect tax rate parameter, \( q \), and the real wage, \( w \). The tax rates are assumed to be policy parameters. The wage rate should be determined with the aid of equations for the labor market, but this market is not included in our analysis and we treat \( w \) as a given.

Substituting and solving for \( \frac{p_r}{p_s} \) as a function of \( w \), \( q \) and \( t \) gives

\[
\frac{p_r}{p_s} = \frac{(a_{32} + a_{42})[1 - (1-t)(a_{12} + a_{22})] w}{(a_{11} + a_{21})q - (a_{31} + a_{41})[1 - (1-t)(a_{12} + a_{22})]}
\]

A very similar result is obtained if the border tax adjustment factor, \( q \), enters both the expenditure and output equations. The only change in solution for this change in assumption is that \( q \) now enters multiplicatively in both terms of the denominator.

The numerator of equation (9) is negative unless the marginal propensity to purchase with respect to disposable income, \( a_{12} + a_{22} \), is considerably above unity. The sign of the denominator, however, depends on the slopes of the expenditure and output equations. Since the price ratio is positive, the denominator must have the same sign as the numerator. A sufficiently large slope \( a_{11} \) of the expenditure function for goods consumed at home relative to the slope \( a_{21} \) of the expenditure function for exported or a sufficiently large response \( a_{31} \) of the output of goods consumed at home relative to the output \( a_{41} \) of goods exported assures that the denominator is negative. These restrictions are important for determining the direction in which relative prices change in response to tax and border tax policies and the size of the response to fiscal policies.
Differentiating (9) with respect to $q$ and $t$, gives

\begin{equation}
\frac{\partial (\frac{p_r}{p_s})}{\partial q} = -\frac{(a_{11} + a_{21})}{\Delta} \frac{p_r}{p_s}
\end{equation}

and

\begin{equation}
\frac{\partial (\frac{p_r}{p_s})}{\partial t} = \frac{(a_{12} + a_{22})}{\Delta} \left[ (a_{32} + a_{42})w + (a_{31} + a_{41}) \frac{p_r}{p_s} \right] = \frac{a_{12} + a_{22}}{\Delta} y < 0,
\end{equation}

where $\Delta$, the denominator of equation (9), is negative by our previous argument.

A rise in the direct tax rate lowers the relative price ratio, increases expenditure on goods consumed at home and reduces expenditure on exportables. If $a_{11}$ is larger (in absolute value) than $a_{21}$, total expenditure increases in response to the change in relative prices. However, the size of the change in relative prices depends on the level of output, as shown in equation (11). The higher the level of output, the larger the change in the relative price ratio and the change in expenditure resulting from the relative price effect of a change in direct tax rates.

Our model suggests a reason for the considerable difference in the value of the fiscal policy multiplier estimated for periods of high and low levels of output. Standard models of "the multiplier" ignore the effect of relative prices on expenditure and overlook the feedback to expenditure.
that partially reverses the effect of changes in disposable income \((a_{12} + a_{22})\) resulting from changes in tax rates or autonomous expenditure. The size of the relative price effects vary, most likely, with the composition of expenditure and, as we have seen, with the level of output, so it is likely that the effects of fiscal policy vary also.

To obtain the total response of aggregate expenditure \((A)\), to a change in direct tax rates implied by our model, we sum the partial response of aggregate expenditure to the change in tax rates, \(-(a_{12} + a_{22})y\), and the response to the induced change in relative prices shown in equation (11). Expressed as an elasticity and denoted \(e(A,t)\), this sum is

\[
(12) \quad e(A,t) = (a_{12} + a_{22}) \left( \frac{1}{A} - 1 \right) \frac{t}{y}
\]

Since \(A\) is negative, the elasticity is negative. However, the size of the elasticity varies directly with the ratio of direct taxes \((ty)\) to total expenditure. As expenditures increase (relative to direct taxes and output), the response to changes in direct (income) tax rates falls. Higher tax rates increase the elasticity by raising the last term, but higher tax rates also change \(\Delta\), and we cannot be certain about the response of the elasticity to changes in tax rates until we know more about the size of \(\Delta\) and its principal components.

An important proposition in Keynesian theory asserts that expansive fiscal policies "pay for themselves." The point of the proposition is that the rise in output and expenditure resulting from the multiplier
effect of tax reduction raise the tax base to a level at which the government receives more revenue at the new than at the old rates.

Translated into our model, the proposition requires that

\[ t_1 \delta A > \delta ty, \text{ or } t_1 \varepsilon(A,t) \frac{\delta t}{t_0} > \delta t \frac{\gamma}{A} \]

where \( t_1 \) is the new and \( t_0 \) the old direct tax rate. For \( y = A \) and small tax changes, the Keynesian proposition implies that \( \varepsilon(A,t) > 1 \) in the case of tax reduction and is slightly less than one for tax increases.

From equation (12), we see that the size of this elasticity depends on the size of \( \Delta \) since the product of marginal propensity to spend \( (a_{12} + a_{22}) \) and the ratio of direct taxes to aggregate expenditure is considerably below unity. If the numerical value of \( \Delta \) is considerably below unity, \( \frac{1}{\Delta} - 1 \) becomes large enough to raise the value of the elasticity above unity.

The denominator of equation (9), \( \Delta \), is numerically small when the slopes of the supply curves \( (a_{31} + a_{41}) \) are relatively flat. This is more likely to occur in periods of deep depression than in periods of economic expansion.

The dependence of the fiscal policy multiplier on the slopes of the supply curves and hence on the size of short-term changes in relative prices induced by changes in tax rates explains both the variability of the multiplier and the higher values of the multiplier estimated for periods of depression. A reduction of direct tax rates induces a larger rise in the relative price of goods consumed at home during periods of prosperity than during periods of depression. The larger the rise in the price of such goods, the greater the reduction in the amount of expenditure and the smaller the combined effect of disposable income and the price
ratio on domestic expenditure. Our model implies, however, that the relative price effect cannot offset the effect of the change in disposable income on expenditure. As we have already noted, \( e(A,t) \) cannot be positive, so the direction of the fiscal policy effect is the same in our model as in the simpler income-expenditure model.

Changes in direct tax rates also affect the balance of trade and payments by changing relative prices and raising or lowering the relative prices of importables and exportables. A rise in the direct tax rate lowers the relative price of the goods consumed in the home country, including imports, increasing real expenditure for these goods. This effect of fiscal policy is generally neglected. In discussions of the so-called assignment problem, fiscal policy is made responsible for "maintaining employment" when exchange rates are fixed. Responsibility for control of the balance of payments is "assigned" to monetary policy. The relative price model, however, implies that at high levels of output, the balance of payments effect of tax changes is relatively large and the effect on domestic expenditure relatively small, so the response of the balance of payments to fiscal policy should not be ignored.

Changes in indirect tax rates and border tax adjustments also change relative prices, but as shown in equation (10) the direction of the relative price change depends on the slopes of the demand curves and the size of the change depends on the prevailing price ratio. An increase in border tax adjustments (an increase in \( q \)) \( q^f \) raises the relative price \( q=1 \) is the limiting case of no border tax adjustment. In the model, \( q \geq 1 \).
of domestic goods if the denominator is negative and the slope of the expenditure curve for goods consumed at home \((a_{11})\) is flatter than the slope \((a_{21})\) of the expenditure curve for goods exported. In this case, the rise in \(\frac{p_r}{p_s}\) resulting from the increases in indirect taxes and border tax adjustments reduces expenditure on imports and works to improve the balance of payments.

Our empirical work involves elasticities rather than slopes. To obtain the elasticity of relative prices with respect to \(q\), we multiply equation (10) by \(\frac{q}{p_r/p_s}\) and obtain

\[
e(p_r/p_s,q) = \frac{-(a_{11} + a_{21}) \ q}{\Delta}.
\]

The response of relative prices to border tax adjustments is proportional to the effective border tax adjustment. As indirect taxes and border tax adjustments increase, \(q\) rises and the response of the price ratio increases.

However, a policy of replacing direct with indirect taxes and increasing border tax adjustments has an indeterminate effect on the relative price ratio. The reason is that the denominator of the elasticity depends on the direct tax rate, and we cannot deduce the direction in which a change in direct taxes changes the elasticity. The model provides no means of determining the direction in which relative prices respond to a change in indirect taxes or a substitution of indirect for direct taxes. Although our model implies that a decrease in direct rates raises the price ratio, the effect of changes in indirect tax rates and border tax adjustments is uncertain.
Some Empirical Findings

The negative response of the price ratio to an increase in direct tax rates implied by the model provides a test of the model, and the positive response to a rise in the effect of real wages \( w \) provides an additional test. To make these tests and estimate the response to a change in \( q \), we assume that the supply elasticities \( a_{31} \) and \( a_{41} \) are of equal order. This permits us to rewrite equation (9) in linear logarithmic form and to estimate the elasticities of \( \frac{p_r}{p_s} \) with respect to \( q \), \( w \) and \( t \) using data for five countries -- Netherlands, West Germany, Japan, the United Kingdom and the United States -- provided by the U. S. Treasury Department. Annual data were available for various periods ending in 1962. The number of annual observations for each country is shown in Table 1.

During the years covered by our data, several of the European countries revised their tax systems, increasing the reliance on indirect taxes and reducing reliance on direct taxes in their fiscal systems. This suggests that the data for \( q \) and \( t \) may be collinear, and Table 1 shows that this is the case. In the Netherlands and Germany, \( t \) and \( q \) changed in opposite directions; in the United Kingdom, \( t \) and \( q \) changed in the same direction. Japan and the U. S. show no apparent relation between the two average tax rates during the period.

__5/ Indexes of wholesale prices and export prices were used for \( p_r \) and \( p_s \) respectively. The ratios of direct and indirect taxes to GNP were used for \( t \) and \( q \).__
TABLE I
Simple Correlation Coefficients between Direct and Indirect Tax Rates for Five Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>No. of observations</th>
<th>Simple correlation between t and q</th>
<th>log t and log q</th>
</tr>
</thead>
<tbody>
<tr>
<td>Netherlands</td>
<td>10</td>
<td>-.61</td>
<td>-.61</td>
</tr>
<tr>
<td>Germany</td>
<td>11</td>
<td>-.71</td>
<td>-.72</td>
</tr>
<tr>
<td>Japan</td>
<td>10</td>
<td>-.08</td>
<td>-.07</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>11</td>
<td>.79</td>
<td>.78</td>
</tr>
<tr>
<td>United States</td>
<td>18</td>
<td>.28</td>
<td>.29</td>
</tr>
</tbody>
</table>

The regression results in Table 2 support the two main implications of the model. The elasticity of relative prices with respect to direct taxes is negative for each of the countries, and the elasticity with respect to real wages is positive. A rise in income tax rates, whether the result of policy action or rising real income that moves taxpayers into higher real tax brackets, lowers the price of domestically purchased commodities relative to the price of exportables. A fall in real wages also lowers the relative price of goods consumed at home. To the extent that increased tax rates reduce real income and real wages in the short-run, the effects of fiscal policy on real wages and of real wages on the price ratio reinforce the direct effect of the change in income taxes. The price ratio falls, and domestic expenditure increases.

6/ Similar results were obtained when the log of real income was added as an explanatory variable. The main difference is that the significance of log w is reduced when y is included.
One rather surprising result is the narrow range within which the elasticities with respect to direct tax rates fall. The data suggest that in four of the five countries a 10% rise in tax rates lowers the relative price of domestic goods by 1-1/4 to 1-1/27.

The computed elasticities of relative prices with respect to indirect tax rates are much less uniform, as the model suggests. There is a tendency for the computed elasticities to be positive in countries with the highest indirect tax rates, but none of the elasticities with respect to indirect tax rates are significant.

To the extent that the data support a conclusion about the short-run effects of substituting indirect for direct taxes and increasing border tax adjustments, it appears that in the Netherlands, Germany, and the United Kingdom a shift in taxes of this kind raises the price of domestically purchased commodities relative to the price of exportables. In Japan and the U.S., both elasticities have the same sign, so the effect on the price ratio depends on the size of changes in the two tax rates.

Before drawing the conclusions about the short-term effect of border tax adjustments on the balance of payments, however, we must recall that exported commodities are consumed at home as well as abroad. Only if the tax policy reduces the price of exported goods relative to the world price can we conclude that exports increase.
<table>
<thead>
<tr>
<th>Country and Multiple R</th>
<th>Direct tax</th>
<th>Indirect tax</th>
<th>Wage rate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Netherlands</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elasticity</td>
<td>-0.074</td>
<td>0.075</td>
<td>0.013</td>
</tr>
<tr>
<td>&quot;t&quot; value</td>
<td>-1.55</td>
<td>0.57</td>
<td>0.37</td>
</tr>
<tr>
<td>Partial r</td>
<td>-0.53</td>
<td>0.22</td>
<td>0.15</td>
</tr>
<tr>
<td>Log of the mean</td>
<td>1.22</td>
<td>1.12</td>
<td></td>
</tr>
<tr>
<td><strong>Germany</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elasticity</td>
<td>-0.125</td>
<td>0.185</td>
<td>0.098</td>
</tr>
<tr>
<td>&quot;t&quot; value</td>
<td>-2.25</td>
<td>1.35</td>
<td>2.32</td>
</tr>
<tr>
<td>Partial r</td>
<td>-0.65</td>
<td>0.45</td>
<td>0.66</td>
</tr>
<tr>
<td>Log of the mean</td>
<td>1.17</td>
<td>1.25</td>
<td></td>
</tr>
<tr>
<td><strong>Japan</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elasticity</td>
<td>-0.159</td>
<td>0.302</td>
<td>0.163</td>
</tr>
<tr>
<td>&quot;t&quot; value</td>
<td>-2.22</td>
<td>-1.82</td>
<td>4.96</td>
</tr>
<tr>
<td>Partial r</td>
<td>-0.67</td>
<td>-0.60</td>
<td>0.90</td>
</tr>
<tr>
<td>Log of the mean</td>
<td>1.01</td>
<td>0.98</td>
<td></td>
</tr>
<tr>
<td><strong>United Kingdom</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elasticity</td>
<td>-0.128</td>
<td>0.421</td>
<td>0.221</td>
</tr>
<tr>
<td>&quot;t&quot; value</td>
<td>-1.18</td>
<td>1.32</td>
<td>6.86</td>
</tr>
<tr>
<td>Partial r</td>
<td>-0.40</td>
<td>0.45</td>
<td>0.93</td>
</tr>
<tr>
<td>Log of the mean</td>
<td>1.17</td>
<td>1.19</td>
<td></td>
</tr>
<tr>
<td><strong>United States</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elasticity</td>
<td>-0.153</td>
<td>0.180</td>
<td>0.295</td>
</tr>
<tr>
<td>&quot;t&quot; value</td>
<td>-2.57</td>
<td>-1.50</td>
<td>3.97</td>
</tr>
<tr>
<td>Partial r</td>
<td>-0.60</td>
<td>-0.40</td>
<td>0.75</td>
</tr>
<tr>
<td>Log of the mean</td>
<td>1.17</td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>
Conclusion

Although we have considered the effect on relative prices of only two very broad types of tax changes, our results suggest that the effects are larger and more important than is implied by their long neglect. In our simplified analysis with exchange rates and capital stock fixed, an increase in direct taxes lowers the price of exported goods relative to the price of goods consumed at home, and a decrease in direct rates raises the price ratio. Empirical evidence for five countries supports this implication and suggests that the elasticity of the price ratio is of approximately the same size in four of the five countries studied.

Our analysis implies that the size of the fiscal policy multiplier varies with the level of output. At low levels of output, an increase in tax rates has little effect on prices of goods consumed in the home country. As output and real expenditure rise, changes in tax rates have larger short-run effects on prices. The larger the response of prices, the smaller the response of expenditure to a change in taxes. Although the model implies that aggregate expenditure moves inversely to the change in tax rates in prosperity as in depression, the model also implies that the size of the response is much smaller in periods of prosperity. As the economy approaches "full employment," the response of output and expenditure per dollar of fiscal change diminishes.

Much of the lay, and some of the professional, discussion of comparative tax systems on a country's balance of trade and payments suggests that countries can for a time pursue "beggar thy neighbor" policies by shifting from direct to indirect taxes and increasing the amount of border tax adjustments. Recently, Germany has reversed this process, reducing border
tax adjustments for the stated purpose of reducing a balance of payments surplus.

Our analysis implies that the effect of border tax adjustments varies from country to country and depends, *inter alia*, on the slopes of the expenditure and supply functions, and the applicable indirect and direct tax rates. Our empirical estimates support this conclusion. The elasticity of the ratio of domestic to export prices is negative in some countries, positive in others. In Germany, the Netherlands and the United Kingdom keeping tax revenues unchanged, a shift from direct to indirect taxes and increased border tax adjustment raises domestic prices relative to export prices. In Japan and the U.S., the effect of border tax policy depends on the relative size of the change in direct and indirect tax rates required to keep tax collections constant. If the rise in indirect tax rates required to compensate for the reduction in direct tax rates is sufficiently large, the relative price of exported goods rises. Border tax policy appears to have a relatively uncertain effect and to be a poor substitute for exchange rate changes as a means of adjusting the effective exchange rate or reducing a persistent balance of payments surplus or deficit.

Most of all, our results suggest that an understanding of the short-term effects of tax and fiscal policy changes requires more knowledge than we currently possess about the response of relative prices to marginal changes in output and expenditure.