THE RESPONSE OF THE CURRENT ACCOUNT TO TERMS OF TRADE SHOCKS: A PANEL-DATA STUDY

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Abstract

This paper demonstrates that the response of the current account to shocks depends on the degree of persistence of these shocks. This result is in accordance with standard intertemporal models that incorporate both consumption smoothing and an investment response to shocks. The estimation procedure used to test this result takes advantage of the fact that the persistence of the terms of trade varies greatly across countries. Countries with the least persistent terms of trade shocks are shown to exhibit a positive relationship between these shocks and the current account; countries with the most persistent terms of trade shocks are shown to exhibit a negative relationship.

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1. Introduction

A standard intertemporal representative-agent model with a non-durable good and no investment predicts that a temporary positive shock to income will lead to an improvement in the current account. Similarly, if there are no borrowing constraints, a temporary negative shock will lead to a fall in the current account. Hence, this classical model of consumption smoothing predicts a positive correlation between temporary income shocks and the current account.

However, the effect of investment works in the opposite direction to the consumption-smoothing effect. If there is a shock to productivity or to the terms of trade, there will be an incentive to alter the capital stock. The change in the capital stock will be greater for more persistent shocks. A purely transitory shock will have no investment effect. A permanent shock will have a strong investment effect. The response of investment to shocks feeds directly into the current account.

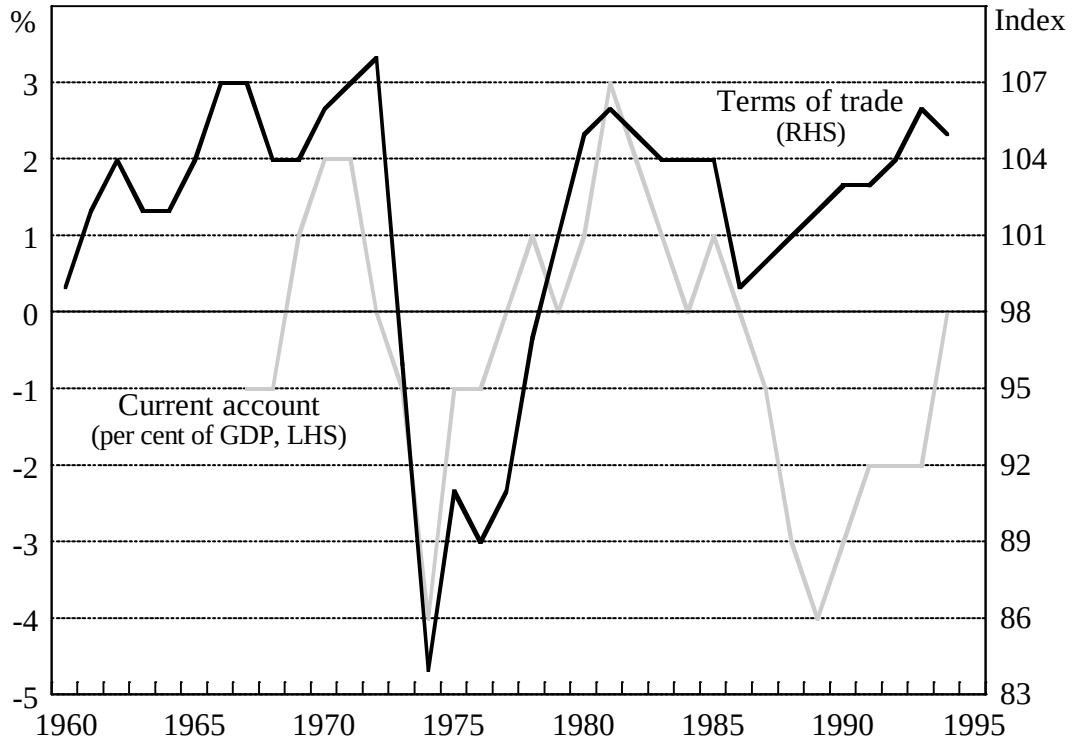
In periods following productivity or terms of trade shocks, the current account can move in the opposite direction to the shock if the investment effect dominates the consumption-smoothing effect. This is more likely the longer the duration of the shock. The implications of this basic theory can be tested by using the fact that the persistence of shocks to the terms of trade varies greatly across countries.

This paper provides evidence on the dynamic relationship between the terms of trade and the current account for a very large sample of countries. The first objective is to evaluate the relative frequency of different dynamic responses across a large sample of countries. The second objective is to determine if the investment

effect dominates the consumption-smoothing effect in countries that have more persistent terms of trade shocks.[1]

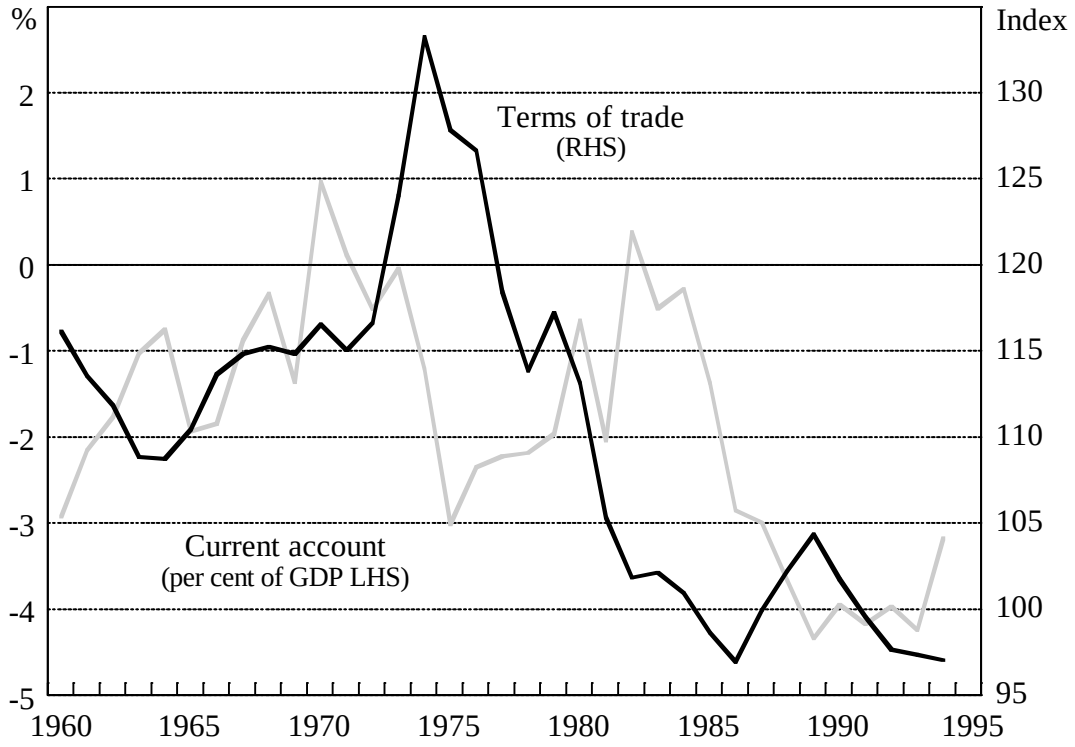
The effect of terms of trade persistence is illustrated in Figures 1 and 2. The United Kingdom has experienced fairly temporary terms of trade shocks, whereas Canada has experienced more persistent terms of trade shocks (this is demonstrated formally later in the paper). For the United Kingdom the terms of trade and the current account are positively correlated, which is consistent with the dominance of the consumption-smoothing effect. Whereas, for Canada, large movements in the terms of trade have been associated with movements of the current account in the opposite direction, which is consistent with the investment effect dominating the consumption-smoothing effect.

Figure 1: United Kingdom – Current Account Balance and Terms of Trade



[1] If investment involves significant fixed costs, then a large temporary shock to the terms of trade should have a different effect from a small temporary shock. I do not consider this possibility, but leave it for future research.

Figure 2: Canada – Current Account Balance and Terms of Trade



Obstfeld and Rogoff (1995) provide an extensive review of the recent theoretical and empirical literature on the intertemporal approach to the current account. They discuss the theoretical importance of the degree of persistence of a shock, but they do not present any direct evidence regarding persistence. There are a number of studies that test the consumption-smoothing hypothesis directly, including Otto (1992), Ghosh (1995), and Ghosh and Ostry (1992, 1995). However, these papers do not require an explicit formulation of the dynamic process of shocks and the implications of this for the current account. Therefore, this literature overlooks the role played by the degree of persistence in the underlying shocks.

Glick and Rogoff (1995) incorporate the investment decision explicitly in their structural estimation of a simple current account model. Their model contains one good and so it is restricted to productivity shocks only. They show that there is a significant negative relationship between productivity shocks (which are highly persistent) and the current account balance.[2] This result is consistent with both their

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[2] The productivity shocks can be decomposed into the country specific shock and the common world shock. They find that this latter component has no effect on the current account which is consistent with theory.

model and mine. However, they have nothing to say about the effects of less persistent shocks.

Backus, Kehoe and Kydland (1994) describe the correlation between the terms of trade and the trade balance across industrialised countries that is consistent with the findings of this paper. They model this fact as an endogenous response of the terms of trade to changes in investment following productivity shocks. However, in my paper the terms of trade are treated as exogenous.

Tornell and Lane (1996a, 1996b) develop a model of a dynamic game between competing fiscal claimants that can explain negative correlations between the current account and temporary terms of trade shocks. That is, following terms of trade changes, the government fiscal position adjusts so much as to undo the consumption-smoothing effect. However, their model cannot explain the results of this paper, which are robust to the inclusion of the government fiscal balance in regressions.

The paper is organised as follows. Section 2 presents a summary of a simple intertemporal representative-agent model that highlights the consumption-smoothing and investment effects. For more persistent shocks the investment effect is dominant and the current account moves in the opposite direction to the shock. The opposite is true for more temporary shocks for which the consumption-smoothing effect dominates. Both terms of trade and productivity shocks are considered. Productivity shocks are predicted to have a negative relationship with the current account because they are typically very persistent. However, terms of trade shocks display a range of persistence across countries and, therefore, could have either positive or negative effects on the current account.

Section 3 outlines and provides results from the first of two different but complementary methodologies. The key to the first approach was to define and then identify various ‘episodes’; that is, a large change in the terms of trade accompanied by some response of the current account. This approach allowed the identification of episodes of negative correlation even within countries for which the consumption-smoothing effect tended to dominate the investment effect more often than not. The other advantage of this approach was that it incorporated countries with only a short period of current account and terms of trade data.

The responsiveness of the current account balance to the terms of trade was estimated using a regression analysis of panel data in Section 4. This approach controlled for the effects of productivity shocks and allowed for an unrestricted dynamic framework. Countries were separated into groups according to the degree of persistence in their terms of trade. The main objective of this section was to determine if the relationship between the current account and the terms of trade varied across these country groups in accordance with the theory of persistence.

The implications of credit constraints and of government fiscal policy are briefly considered in Section 5 before some concluding remarks.

2. Theoretical Framework

This section describes a simple model of the current account that incorporates the consumption-smoothing and investment effects and highlights the role of the degree of persistence of shocks. The model is of a small open economy facing a given world interest rate. The economy consists of a single infinitely lived representative agent. The agent is assumed to supply one unit of labour inelastically. The agent's problem is to choose the path of investment and consumption so as to maximise lifetime utility, which is given by

$$U = \sum_{t=0}^{\infty} \frac{u(c_t)}{(1+\delta)^t}, \tag{1}$$

where c_t is consumption at time t, δ is the agent's rate of time preference and $u(\circ)$ is a time-separable utility function with the usual properties, that is, $u' > 0$ and $u'' < 0$. Uncertainty is unnecessary for the basic results and so it is not incorporated into the model.[3]

There are only two goods in this model, an import good and an export good. The agent consumes only the import good, and the export good is the only good produced domestically. The price of imports is normalised to one, and the price of

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[3] Uncertainty is discussed later in the paper when it becomes relevant to the estimation methodology.

exports is p_t. Hence, the terms of trade are also equal to p_t. Exports, y_t, are produced according to the following production function,

$$y_t = A_t f(k_t), \tag{2}$$

where *k* is the level of the capital stock; also, $f' > 0$ and $f'' < 0$. The unit price of capital is fixed and equal to one (by the appropriate choice of units).

The law of motion of the capital stock is

$$k_{t+1} = k_t + i_t. \tag{3}$$

The depreciation rate on capital is set to zero for simplicity.

The agent can borrow or lend on the world capital market at the fixed interest rate $r_t = r$ (denominated in units of imports). The agent's dynamic budget constraint is therefore,

$$\Delta b_{t+1} = r b_t + p_t y_t - c_t - \Delta k_t, \tag{4}$$

where b_t is the stock of net foreign assets at the beginning of time period *t* and Δ is the first difference operator. Equation (4) is also the definition of the current account balance which is the change in net foreign assets, Δb_t.[4]

The optimal level of the capital stock is given by equating the marginal value product of capital to the world interest rate,

$$p_t A_t f'(k_t) = r. \tag{5}$$

Equation (5) shows the optimal level of the capital stock at time *t*. Implicitly,

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[4] Also, there is the transversality condition, $\lim_{t\to\infty} \frac{b_t}{(1+r)^t} = 0$, which prevents the agent from building up debt to levels so high that it can only be financed by rolling over the debt by further borrowing.

Equation (5) shows that investment at time *t-1* depends on the expectation at *t-1* of the terms of trade and productivity at *t*. That is,

$$i_{t-1} = f'^{-1}(r / E_{t-1}(p_t A_t)) - k_{t-1},$$

where $f'^{-1}(\circ)$ is the inverse function of $f'(\circ)$ and $E_{t-1}(\circ)$ is the expectations operator taken at time *t-1*.

In this very simple model, shocks to the terms of trade have exactly the same effect as productivity shocks. Specifically, the elasticity of the capital stock with respect to the terms of trade is equal to the elasticity of the capital stock with respect to productivity,

$$\frac{\partial k}{\partial p}.\frac{p}{k} = \frac{\partial k}{\partial A}.\frac{A}{k} = \frac{-f'}{k f''} > 0. \qquad (6)$$

A more realistic model would have more than one sector producing goods. In the case of a positive terms of trade shock, the export sectors would expand and the import-competing sectors would contract (non-traded sectors could go either way). In such a model, an increase in the terms of trade would have less of an impact than an equal percentage increase in productivity (across all sectors). However, so long as a positive terms of trade shock leads to an aggregate increase in investment, the results that follow will still hold qualitatively.

In this model, the response of investment is dependent on the duration of the shocks. There is insufficient time to observe and then respond to a purely transitory unanticipated shock. However, for more persistent shocks, investment will respond according to Equation (5). The investment effect by itself leads to a negative correlation between the shock and the current account in the period that the shock is observed.

In reality, the response of investment may be delayed and more drawn out than is implied by this simple model.[5] This could be due to a number of factors that may

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[5] Also, consumption may not adjust instantaneously to shocks. I ignore this issue by presuming that consumption responds more rapidly than investment.

exist in the real world, including: delayed learning about the true nature of a shock[6]; quadratic costs of adjusting the capital stock; and time to install and remove capital equipment (Glick and Rogoff 1995; Obstfeld and Rogoff 1995).

The other choice variable in the agent's maximisation problem, besides investment, is the level of consumption in each period. Consumption behaviour is determined by the Euler equation of this problem:

$$\frac{u'(c_{t+1})}{u'(c_t)} = \frac{1+d}{1+r}. \tag{7}$$

I assume that $d = r$ for expositional purposes. Given the assumption of strict concavity of the within-period utility function, this implies a flat consumption path.[7] Consumption will be equal to the level of permanent income, namely

$$y_t^p = r\left[b_t + \sum_{j=t}^{\infty} \frac{p_j y_j}{(1+r)^{j-t}}\right]. \tag{8}$$

The consumption-smoothing effect is simply that consumption equals permanent income and, therefore, any differences between permanent and current income are reflected in the current account balance.[8]

The effect of a shock is best illustrated by a simple example. If $p_t = p$ and $A_t = A$ are constant, then permanent income will equal actual income and the current account will be equal to zero. Starting from this initial steady state at time $t = 0$,

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6 This is particularly important if investment involves fixed costs.

7 With $d \neq r$ the consumption path has a trend. The current account will also exhibit a trend except for the special case where the paths of A_t and p_t imply the same trend for both consumption and income. These possibilities are dealt with in the empirical section of this paper by detrending all of the series.

8 Actual income is equal to the sum of interest income on net foreign assets and export income, $rb_t + p_t y_t$.

consider a shock to either productivity and/or the terms of trade as follows:

$$p_t A_t = \begin{cases} pA(1+e) & for \quad t = 0, 1, \ldots, t \\ pA & for \quad t = t+1, t+2, \ldots \end{cases}. \tag{9}$$

Consider a positive shock, $e > 0$ (although the argument is symmetric for negative shocks).[9] There are three cases to consider depending on the persistence of the shock.

Case 1: The shock is **permanent**, $t = \infty$.

Investment increases today, but the capital stock does not reach its new level until the following period. Hence, current income rises today but by less than permanent income. The consumption-smoothing effect leads to a current account deficit today. The investment effect also causes a current account deficit in the same period that the shock is realised. (A small current account surplus in all future periods ensures that the intertemporal budget constraint is satisfied.)

Case 2: The shock is **purely temporary**, $t = 0$.

There is no investment effect because there is not enough time to react to the shock. Current income rises by more than permanent income and so the consumption-smoothing effect implies a current account surplus at the time of the shock.

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[9] It is possible that a persistent large negative terms of trade shock could lead to significant investment in an industry which had so far been relatively minor – for example, the first oil shock could have led to significant investment (and hence, current account deficits) to exploit previously untouched oil resources. However, this did not appear to be relevant for any of the countries with very persistent terms of trade shocks (Section 4.3).

Case 3: The shock is **temporary** but **persistent**, $0 < t < \infty$.

Now permanent income rises by less than current income.[10] The consumption-smoothing effect leads to a current account surplus in all periods from $t = 0$ to t. The magnitude of the consumption-smoothing effect is decreasing with higher persistence, t, because permanent income is closer to current income, the greater the persistence of the shock. The investment effect leads to a current account deficit in the period that the shock occurs. The net effect of consumption-smoothing and investment depends on the degree of persistence of the shock. For less persistent shocks, the consumption-smoothing effect will dominate and there will be a positive correlation between the shock and the current account (in the period of the shock). For some degree of persistence, the two effects will cancel each other out. At higher degrees of persistence, the investment effect will dominate and there will be a contemporaneous negative correlation between the shock and the current account.

The key to this paper was to identify two groups of countries based on the degree of persistence of their terms of trade shocks – those with more temporary shocks for which the consumption-smoothing effect should dominate and those with very persistent shocks for which the investment effect should dominate. This is taken up in Section 4 of the paper after a preliminary look at the data in Section 3.

3. Counting Episodes

This section of the paper determines the relative frequency of episodes of positive and negative correlations between the current account and the terms of trade at frequencies of one and two years. The episodic methodology used here is useful because it does not presume that changes in the terms of trade within a country were always either entirely temporary or entirely permanent. Because of this, the results can be regarded as complementary to the regression analysis of Section 4.

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[10] Although this need not be the case for a very persistent shock. In this case, at time $t = 0$, it could be that the one period delay in the capital stock adjustment means that current income is less than permanent income, in which case the story is much like in the case where $t = \infty$.

3.1 Data Description

The data are from various sources – full details are provided in Appendix B. Series are annual from 1960 to 1994, although many countries have a much shorter sample period. I have included 128 countries in my sample. The countries are listed in Table A1 in Appendix A. The two variables introduced in this section are the current account balance (as a proportion of GDP) and the terms of trade. The terms of trade were constructed from the ratio of export to import price indices where possible, otherwise they were based on export and import unit value indices or on estimates provided by the World Bank. Despite the less than ideal data for some countries there was no reason to expect any systematic bias in the terms of trade series.

I leave a discussion of the important issue of stationarity until the estimation of the econometric model. At this stage, it is sufficient to point out that many countries in the sample appeared to have non-stationary terms of trade. This was dealt with in this section of the paper by transforming the data to ensure that variables are integrated of the same order (that is, stationary or I(0) variables). The terms of trade index for each country was transformed by demeaning the annual growth rate of the series. The current account (as a per cent to GDP) was transformed by demeaning the first difference of the series.

3.2 Episodic Approach

The average contemporaneous correlation between the current account and the terms of trade across all countries was 0.21. The average correlation with the terms of trade lagged by one year was -0.15. (The lagged correlation allows for a delayed or slow response of the current account balance to changes in the terms of trade.[11]) For countries that had negative correlations (both contemporaneous and lagged), it was most often the lagged correlation that was larger in absolute value (Table A1 in Appendix A for country results). These simple correlations suggest that there were countries for which terms of trade shocks were very persistent and hence, the investment should have dominated the consumption-smoothing effect. However,

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[11] If the net real trade balance does not react contemporaneously to a rise in the terms of trade, the current account will automatically rise; that is, a positive contemporaneous correlation will occur if there is no instantaneous response of trade volumes.

many countries were likely to have had episodes of both very transitory and very persistent terms of trade shocks. This section of the paper addressed this problem by counting episodes of correlations within each country.

There are 3 043 observations (that is, country years) in the full sample. For each country, I calculated the sample standard deviations of the transformed current account balance and the terms of trade and then asked the following question:

What happened to the current account balance in years when the terms of trade changed by more than one standard deviation?

Within this set of observations I considered six possibilities. These are shown in Table 1. Large positive and negative changes in the terms of trade are split into columns 1 and 2 respectively. The response of the current account is divided into one of three rows in Table 1; that is, large positive, large negative or small changes in the current account (large being greater than one standard deviation). The two shaded boxes in the table represent negative correlations between the terms of trade and the current account balance.

Table 1: Current Account Changes During Years with Large Changes in the Terms of Trade

One-year window

	Positive terms of trade changes	Negative terms of trade changes	
Large positive changes in the current account	74 (9%)	35 (4%)	
Small changes in the current account	310 (37%)	282 (34%)	
Large negative changes in the current account	38 (5%)	89 (11%)	Total
			828

Almost 30 per cent of large changes in the terms of trade were associated with large changes in the current account. Almost one third of these episodes were negative correlations.

Table 1 only captures high-frequency changes. The following extension allowed the current account a longer time to respond to changes in the terms of trade. First, two-year episodes of either consecutive rises or consecutive falls in the terms of trade were identified. This set of observations was further reduced by keeping only those observations for which the change in the terms of trade over the two years was larger in absolute value than one standard deviation. The response of the current account balance during each two-year period was then recorded. These results are displayed in Table 2 – in order to be comparable to Table 1, in Table 2 each year of each two-year episode was counted separately.

Table 2: Current Account Changes During Years with Large Changes in the Terms of Trade

Two-year window

	Positive terms of trade changes	Negative terms of trade changes	
Large positive changes in the current account	216 (11%)	120 (6%)	
Small changes in the current account	622 (31%)	678 (34%)	
Large negative changes in the current account	108 (5%)	276 (14%)	Total
			2 020

The point estimates from Table 2 show that 11 per cent of large changes in the terms of trade were associated with a large movement of the current account in the opposite direction (over a two-year window). These episodes of negative correlation were almost half as frequent as episodes of positive correlation between large terms of trade changes and large current account changes.[12]

[12] It was not possible to test a null hypothesis of perfect consumption smoothing (that is, no investment effect). This would be equivalent to testing if the frequency of negative correlations is significantly greater than zero which would always be rejected in the case where the point estimate is non-zero.

Many of the observations in Table 1 do not appear in Table 2. Therefore, it makes sense to combine the results of the two tables (making sure to not double count the same country year observation).[13] The results from this aggregation were similar to results for the tables shown above and are not reported in the paper. However, the individual country results for one- and two-year windows combined are provided in Table A1 (in Appendix A), which gives the breakdown according to the total number of years of positive, negative and zero correlation episodes. Countries tended to have episodes of both negative and positive correlations, although there were countries with either no positive or no negative correlation episodes. The interesting question is whether these episodes reflect the terms of trade persistence of different countries in the way that theory would suggest. This is taken up in the next section of the paper.

4. Panel-data Regressions

4.1 Methodology

To begin with, I used a panel-data regression to estimate the dynamic relationship between the current account and the terms of trade across the full set of countries. Then, two groups of countries were identified – one group that tended to have highly transitory terms of trade shocks, and the other group that tended to have highly persistent terms of trade shocks. Finally, the regression analysis was repeated using these two country groupings to test the persistence hypothesis.

Panel data was more appropriate than individual-country regressions given the limited number of annual observations and large number of countries in the sample. Also, panel regressions allowed countries to be grouped together according to the

[13] There is a problem of double counting for some years. That is, under Table 1, a given year might be classified as a negative correlation, whereas over the two-year window the same year is classified as a positive correlation. This problem was avoided by classifying such years as a zero correlation (this occurrence was very rare).

degrees of terms of trade persistence. The panel-data regression was of the following basic form:

$$\Delta CA_{it} = \sum_{j=1}^{4} a_j \Delta CA_{it-j} + \sum_{j=0}^{4} b_j \Delta TOT^S_{it-j} + \sum_{j=0}^{4} g_j \Delta GDP^S_{it-j} + u_{it}, \qquad (10)$$

where: ΔCA_{it} is a transformation of the annual current account balance (as a per cent of nominal GDP, for country i at time t) obtained by demeaning the first difference of the original series; ΔTOT^S is the shock or innovation (see below) to the annual growth rate of the terms of trade; and ΔGDP^S is the shock to the annual growth rate of real GDP. Exact details of the original series and their sources are provided in Appendix B.[14]

There are some important issues related to the choice of this specification that need to be addressed, including the inclusion of real GDP, the nature of the transformations of the variables, the identification of shocks, the lag structure and the question of exogeneity.[15]

The theory discussed in Section 2 implies that changes in productivity are likely to be an important determinant of the current account. However, for many countries in this study, data on productivity are unavailable or at best very unreliable. Real GDP growth was used as a proxy for productivity growth. I checked that this would not affect the results significantly by using the set of OECD countries[16] for which somewhat reliable estimates of the Solow residuals exist. Specifically, I ran the regressions first with the Solow residuals and then with real GDP growth in place of

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[14] Because the changes in the terms of trade are often very large, the log difference is not a good approximation of the growth rate of this series. Therefore, growth rates of the terms of trade and real GDP were both calculated as year-to-year percentage changes.

[15] One extension considered, but not presented here, was to weight each country's terms of trade by a measure of openness (exports plus imports as a per cent of GDP). This would control for the fact that the current account of a very closed country should respond less to a terms of trade shock than a very open country. However, this weighting scheme did not substantially alter the conclusions and only made the interpretation of the elasticities difficult. Also, the two country groupings developed below have similar distributions of openness.

[16] Luxembourg was excluded from the results. This left 23 OECD countries in the sample.

the Solow residuals. The results were very similar and suggested that this substitution would not bias the results for the full set of countries. I do not report the results for the OECD-country regressions (they are available upon request).

As well as reflecting productivity shocks, real GDP growth also captures cycles in demand. However, I expect that the current account response should be similar for both demand and supply shocks. That is, following a positive demand shock, the current account should fall because the increase in investment will be likely to dominate a rise in savings. It is a stylised fact of business cycles that both investment and consumption are procyclical, and that investment is more variable than output which in turn is more variable than consumption. Hence, both investment and savings will typically rise with output. However, the rise in investment should dominate because the ratio of investment variability to output variability is typically much higher than the ratio of output variability to consumption variability.[17]

The data were transformed so as to ensure that all variables were integrated of order zero, which was necessary for valid statistical inference. Tests of stationarity (discussed in detail later in this section) revealed that a large number of countries showed evidence of non-stationary terms of trade in levels, while others showed evidence of stationarity. The level of real GDP is likely to be non-stationary (even about a deterministic trend) for most countries.[18] Finally, the current account balance shows evidence of trend behaviour within the sample period for some countries.[19] Differencing the current account along with the other variables avoids the problem of spurious regressions due to either stochastic or deterministic trends.

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[17] For a summary of stylised real business cycle facts for a number of countries, see Danthine and Donaldson (1993).

[18] Glick and Rogoff (1995) have shown that the Solow residuals of the G-7 countries follow a random walk in levels (based on manufacturing data). Therefore, shocks to productivity are permanent or, at the very least, very persistent.

[19] As mentioned before, this trend behaviour could be due to differences between a country's discount rate and the world interest rate and/or expectations of trends in productivity or the terms of trade.

4.1.1 Identifying shocks

The objective of this section is to measure the response of the current account to *unexpected* changes in the terms of trade. Terms of trade changes may contain a predictable component. In this case the terms of trade changes will be an imperfect proxy for terms of trade shocks.[20, 21] Shocks to the terms of trade were constructed for each country as the estimated residual from the following regression:

$$\Delta TOT_{it} = c_i + \sum_{j=1}^{3} q_{ij} \Delta TOT_{it-j} + u_{it}, \qquad (11)$$

where, ΔTOT_{it} is the growth rate of the terms of trade in country *i* at time *t*, and c_i is a constant term for country *i*. The terms of trade shock is $\Delta TOT_{it}^{S} = \hat{u}_{it}$. This specification used three lags of the growth rate of the terms of trade to be consistent with the results of the Augmented Dickey-Fuller tests conducted later on in this section. Shocks to the growth rate of real GDP were constructed in a similar fashion for consistency.[22]

Equation (10) is a fixed effects model because the data have already been demeaned country by country. Hence, there was no need for a constant term in Equation (10).[23]

The lag structure of Equation (10) was chosen for a number of reasons that are not apparent from the simple theory of Section 2. In particular, this structure allowed for

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[20] Except in the case where the terms of trade follows a random walk, which appears to be the case for many countries with very persistent terms of trade shocks.

[21] The use of the actual changes in the terms of trade and real GDP (as imperfect proxies for the shocks) in the estimation of Equation (10) biases coefficient estimates towards zero but it did not substantially alter the main findings (these results are not reported).

[22] The sample size was not sufficient to allow the construction of *ex ante* shocks by using recursive regressions (that is, the first regression in the recursion would require a sample that ends just prior to the start of the sample period used in the panel-data regressions).

[23] However, all standard errors reported in the paper have the appropriate degrees of freedom correction that accounts for the fact that country means are estimated before panel-data regressions were conducted.

uncertainty and adjustment costs. If investment involves quadratic adjustment costs, as in Glick and Rogoff (1995), the adjustment of the capital stock will be gradual. If investment involves fixed costs, then the adjustment could be delayed. Delayed adjustment of both consumption and investment will in part depend on uncertainty – it may take time to observe shocks and determine their likely size and persistence.[24]

Another source of dynamics comes from contracts which lock in the real level of imports and exports for some time. This possibility, as well as the time it takes to observe and then react to a shock, suggests an automatic positive correlation between the current account and the contemporaneous terms of trade. To the extent that this lack of response is not optimal, the current account will adjust in periods following the terms of trade shock.

When estimating Equation (10), it was assumed that the terms of trade and productivity growth (proxied by real GDP growth) were both exogenous with respect to the current account. For the terms of trade, this assumption was certainly valid for most of the 'small' countries in the sample, that is, those countries that have little influence on world prices. The possible endogeneity for a few large countries was ignored, other than to be careful that country groupings were not dominated by large countries. However, the influence of the Organisation of Petroleum Exporting Countries on oil prices was considered important and is accounted for below.

The causality running from the current account to the productivity shocks is tenuous and likely to be indirect.[25] For developing countries in particular, the level of imports of new capital equipment will embody new technology and therefore affect the productivity level. However, capital equipment is only a part of total imports of goods and services which in turn is only a component of the current account.

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[24] For example, in the early stages of the Gulf War of 1990/91, the oil price rose dramatically then fell back towards pre-war levels before the end of the year.

[25] A very indirect link would be through the potential for a large shock to the current account to induce changes in the real exchange rate that lead to changes in sectoral composition and, hence, aggregate productivity changes. [Thanks to Richard Eckaus for pointing out this link.]

Before discussing the crucial topic of the terms of trade persistence, I present the results for the full set of countries. This provides a useful base line comparison for later country group results.

4.2 Results for the Full Set of Countries

The panel-data regressions for the full set of countries were based on a set of 96 countries. Data limitations meant that many of the 128 countries used in Section 3 were excluded from the regression analysis. Countries that had all the necessary series over the years 1970 to 1992 (as marked in Table A1) were included in the regression analysis. A few countries had missing current account data for one year of the sample, usually 1970 (Appendix A). To enable these countries to remain in the sample, these missing country years were dealt with by running an unbalanced panel-data regression.[26]

The estimation procedure was Feasible Generalised Least Squares, which was used to correct for heteroskedasticity across countries.[27] The estimates of both the full and the parsimonious model are reported in Table 3 below. The preferred model here and in the rest of the paper is the parsimonious model that is obtained by eliminating lags of variables with insignificant coefficients.

The results from the parsimonious model show that across the 96 countries, on average, a large positive shock to the terms of trade has a small but significant positive effect on the current account over a five-year period following the shock. The year by year effects indicate that the current account rises in the same year as a positive shock to the terms of trade shock and then falls in following years. Productivity shocks (via the proxy of real GDP growth) have the expected negative effect on the current account in all years following the shock.

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[26] Starting the sample period for all countries in 1971 would eliminate the 1974 oil shock when four lags of the current account are included on the right-hand side of Equation (10).

[27] Estimates of variance of the residuals used in FGLS were based on the fully specified model, not on the more parsimonious models reported below. However, any residual heteroskedasticity was corrected by using the Newey-West estimates of the final covariance matrix.

Table 3: Panel Data FGLS – Full Sample of 96 Countries

Dependent variable – *DCA*, period of estimation – 1970 to 1992

		Full model	Parsimonious model
Variable	Lag	Coefficient (t-statistic)	
ΔCA	1	-0.265 (-10.14)	-0.259 (-9.94)
	2	-0.258 (-11.18)	-0.270 (-12.34)
	3	-0.137 (-5.99)	-0.153 (-6.96)
	4	-0.126 (-5.60)	-0.131 (-5.90)
ΔTOT^S	0	0.077 (11.79)	0.078 (11.93)
	1	-0.024 (-4.23)	-0.024 (-4.10)
	2	-0.010 (-1.86)	–
	3	-0.006 (-1.22)	–
	4	-0.019 (-2.93)	-0.018 (-3.65)
ΔGDP^S	0	-0.135 (-6.86)	-0.137 (-6.97)
	1	-0.074 (-4.82)	-0.076 (-4.96)
	2	-0.033 (-2.18)	-0.040 (-2.51)
	3	0.020 (1.32)	–
	4	-0.031 (-2.20)	-0.036 (-2.52)
$\sum_{j}^{4} \Delta TOT_{t-j}^{S}$		0.016 (1.31)	0.036 (3.71)
$\sum_{j}^{4} \Delta GDP_{t-j}^{S}$		-0.253 (-6.31)	-0.288 (-8.22)
		No. Obs 1824	No. Obs 1824
		$R^2 = 0.28$	$R^2 = 0.27$

Notes: Standard errors obtained by using the ROBUSTERRORS command in RATS (damp set to one and lags set to 4). This provides Newey-West estimates of the covariance matrix corrected for heteroskedasticity and for serial correlation of a moving average of order 4.

4.3 Stationarity, Persistence and Trends in the Terms of Trade

The stationarity and persistence of the terms of trade are closely related and are crucial to both the methodology and the interpretation of the results. The ADF test was used to determine whether each terms of trade series is stationary or

non-stationary, as well as to provide an estimate of the persistence of terms of trade shocks. The underlying model was assumed to be an autoregressive process for the logarithm[28] of the terms of trade with lag length, p, as follows:

$$(1 - f_{i1}L - f_{i2}L^2 - ... - f_{ip}L^p)\, tot_{it} = e_{it}\,, \tag{12}$$

where L is the lag operator and tot_{it} is the logarithm of the terms of trade for country i at time t. A natural measure of persistence for country i is

$$r_i \equiv f_{i1} + f_{i2} + ... + f_{ip}\,. \tag{13}$$

From the Beveridge-Nelson decomposition, it follows that this model can be rewritten in the form of the ADF test,

$$tot_{it} = r_i\, tot_{it-1} + a_{i1}\Delta tot_{it-1} + a_{i2}\Delta tot_{it-2} + ... + a_{ip-1}\Delta tot_{it-p+1} + e_{it}\,, \tag{14}$$

where $a_{ij} = -\sum_{k=j+1}^{p} f_{ik}\,, \quad 1 \le j \le p-1.$

The null hypothesis is that the terms of trade is integrated of order one, I(1), in other words, that $r_i = 1$. The standard form of the test also allows for a constant and a time trend in Equation (14). The lag length, p, was chosen to give a parsimonious model while ensuring that the estimated residuals, $\hat{e}_{it}$, showed no sign of serial correlation. The tests were conducted on each country's terms of trade over the full length of data available for that country.

The objective was to choose two groups of countries according to the persistence of their terms of trade. One obvious criteria was stationary versus non-stationary terms of trade. However, the results of the ADF tests were not clear for all countries. In particular, results often depended on borderline decisions regarding the appropriateness of a deterministic trend, or whether to use 5 or 10 per cent critical

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[28] The logarithm is not a good approximation for the growth rate as discussed in a previous footnote. However, in this case it is necessary to use the logarithm so as to follow the ADF procedure which requires the variable in levels and first differences.

values. In part, the problem was that these tests suffer from weak power which is particularly true for small sample sizes.

Ideally, countries would have been split into different groups according to *ex ant*e information regarding the behaviour of their terms of trade, not *ex post* information such as I have used. However, this was not possible because of the already limited sample size. Instead, I adopted an approach that identified those countries with terms of trade that were at the extreme ends of the spectrum of terms of trade persistence. In this way, each grouping contains countries that can be considered *most likely* to have had either the most or the least persistent terms of trade shocks *ex ante*.[29]

4.3.1 Least persistent terms of trade country group

The critical criteria for inclusion in this grouping was a stationary terms of trade. I chose a group of 10 countries based on stationarity around a mean (using a 10 per cent significance level). Countries with trend-stationary terms of trade were excluded because I felt that it would be hard for agents to differentiate between a trend and a preponderance of persistent shocks in one direction.[30]

The 10 countries included in the least persistent group were: Finland, Iceland, Israel, Jamaica, Jordan, the Republic of Korea, Mali, New Zealand, Panama and the United Kingdom. The average estimate of persistence for this group was 0.58.

4.3.2 Most persistent terms of trade country group

The criterion for inclusion in the most persistent group was a non-stationary terms of trade with a point estimate of persistence above 0.85 under two different tests. The

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[29] The terms of trade may consist of both temporary and permanent components; however, the objective was to identify countries for which one of these components dominated the other.

[30] A criteria based on stationarity around a mean, at a 5 per cent significance level, left too few countries in the sample. Other possibilities that were investigated included stationarity (including trend stationarity) at a 5 per cent significance level with a point estimate of persistence, $\hat{r}_i$, below 0.55. Results for this group of 15 countries were consistent with those reported below. These 15 countries were: Australia, Bangladesh, Costa Rica, Finland, Jamaica, Jordan, Malawi, Mali, Morocco, Papua New Guinea, Portugal, Sudan, Thailand and Uruguay.

first was an ADF test including both a trend and a constant; the second was an ADF test with a constant but no trend. Both tests were done with lags, p, set equal to 3 and at the 5 per cent level of significance.[31] The point estimates of persistence from both of these tests are provided for all 128 countries in Table A1. Some countries have terms of trade that display a high degree of persistence as measured by the ADF test, including both a trend and a constant but not with a constant alone (and vice versa). Hence, it was thought that countries meeting both of these tests would be most likely to have had *ex ante* very persistent terms of trade.

The influence of the two oil price shocks is strongly evident in the terms of trade of many countries meeting these criteria. A further refinement was to exclude members of OPEC from this set because these countries influenced their terms of trade by restricting sales and production of oil and, presumably, investment in their oil industries.[32] Therefore, to the extent that the cartel was successful, OPEC members should have the consumption-smoothing effect dominating the investment effect, whereas theory suggests the opposite for countries with highly persistent terms of trade shocks.

The set of 11 countries satisfying the conditions for very persistent terms of trade were: Bolivia, Botswana, Canada, Italy, Kenya, South Africa, Spain, the Syrian Arab Republic, Tanzania, Trinidad and Tobago and the United States. It turns out that for this group the null hypothesis of a random walk in the terms of trade cannot be rejected.

4.4 Results Based on Persistence of Terms of Trade Shocks

The theory outlined in Section 2 implies that more persistent terms of trade shocks will be negatively correlated with the current account while more temporary shocks will be positively correlated. Before presenting the evidence from the panel-data regressions, it is worth reviewing the results from counting correlation episodes in Section 3 in the light of the two groups of countries above. Recall that a correlation episode describes the response of the current account to large movements in the

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[31] Three lags were sufficient for most countries to remove any serial correlation in the residuals of Equation (14). Relaxing the criteria to be either p equals 3, 2 or 1 did not alter the results substantially from those presented below.

[32] That is, the terms of trade is not exogenous for the case of OPEC countries.

terms of trade over periods of one and two years. Countries within the higher persistence group should have had relatively more episodes of negative correlations between the current account and large terms of trade changes than those of the low persistence group. The average number of positive, negative and zero correlation episodes per country within each group is shown in Table 4.

Table 4: Terms of Trade Persistence and Episodes of Correlation Between ΔCA and ΔTOT

	Average number of correlation episodes per country		
	Positive	Zero	Negative
11 countries with highest terms of trade persistence	3.9	7.4	3.6
10 countries with lowest terms of trade persistence	5.0	8.9	2.3

These results are broadly consistent with the theory that persistence is an important determinant of the dynamics of the current account with respect to terms of trade shocks. Countries with the most persistent terms of trade shocks have had on average more negative correlations (3.6 compared to 2.3) and less positive correlations (3.9 compared to 5.0) than countries with the least persistent terms of trade shocks.

This finding was confirmed by the results of panel-data regressions on the high and low persistent country groupings in Table 5.

For countries with highly persistent terms of trade, the sum of coefficients on the terms of trade shocks was significantly negative (at the 5 per cent level). For countries that have the least persistent terms of trade, the coefficient on the contemporaneous terms of trade shock was positive and was the only significant lag in the regression. The coefficient on real growth (as a proxy for productivity shocks) was significantly negative, which was expected given the high degree of persistence of these shocks. As predicted by a model with more than two sectors, the effect of real growth was much larger in absolute value than the effect of the terms of trade.

Table 5: Panel Data FGLS – Highest versus Lowest TOT Persistence

Dependent variable – *DCA*, period of estimation – 1970 to 1992

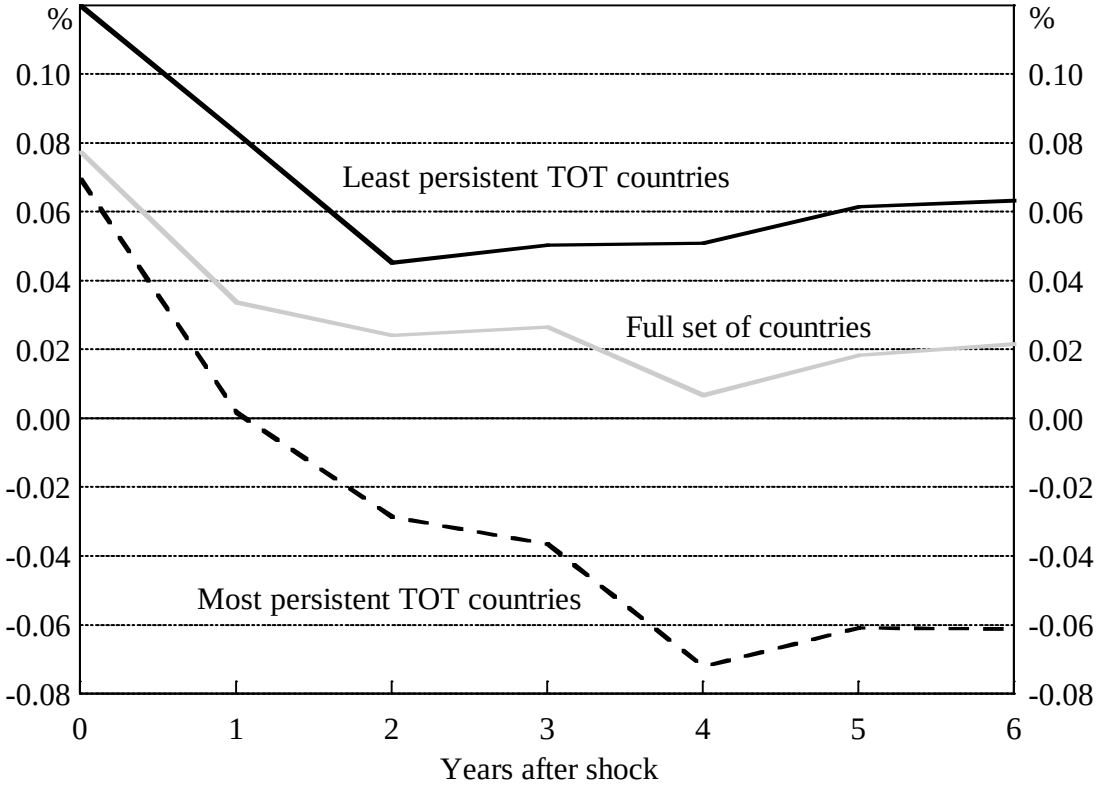
		11 countries with highest TOT persistence		11 countries with lowest TOT persistence	
		Full model[(a)]	Parsimonious model	Full model[(a)]	Parsimonious model[(a)]
Variable	Lag	Coefficient (t-statistics)			
ΔCA	1	-0.198 (-2.40)	-0.161 (-2.50)	-0.322 (-3.80)	-0.307 (-4.05)
	2	-0.114 (-1.77)	–	-0.424 (-6.05)	-0.409 (-6.13)
	3	-0.202 (-3.52)	-0.184 (-2.90)	-0.186 (-2.95)	-0.180 (-3.35)
	4	-0.110 (-1.84)	–	-0.177 (-2.70)	-0.165 (-2.95)
ΔTOT^S	0	0.072 (2.63)	0.070 (3.85)	0.128 (2.67)	0.124 (2.78)
	1	-0.055 (-2.05)	-0.056 (-3.03)	0.024 (0.58)	–
	2	-0.033 (-1.58)	-0.041 (-2.19)	0.005 (0.16)	–
	3	-0.005 (-0.31)	–	-0.025 (-0.91)	–
	4	-0.051 (-2.55)	-0.049 (-2.64)	0.019 (0.73)	–
ΔGDP^S	0	-0.197 (-3.84)	-0.202 (-4.62)	-0.158 (-2.15)	-0.146 (-1.98)
	1	-0.002 (-0.04)	–	-0.190 (-2.72)	-0.185 (-2.60)
	2	-0.046 (-1.00)	–	-0.107 (-1.91)	-0.123 (-2.01)
	3	0.020 (0.51)	–	-0.162 (-2.07)	-0.159 (-2.13)
	4	0.012 (0.30)	–	-0.043 (-0.62)	– –
$\sum_{j=0}^{4} \Delta TOT^S_{t-j}$		-0.072 (-1.77)	-0.077 (-2.13)	0.150 (1.86)	0.124 (2.78)
$\sum_{j=0}^{4} \Delta GDP^S_{t-j}$		-0.213 (-1.87)	-0.202 (-4.62)	-0.662 (-3.46)	-0.612 (-4.07)
		No. Obs 209	No. Obs 209	No. Obs 190	No. Obs 190
		$R^2 = 0.34$	$R^2 = 0.31$	$R^2 = 0.30$	$R^2 = 0.30$

Notes: (a) Indicates standard errors corrected for heteroskedasticity and for serial correlation.

The impulse response functions in Figure 3 show the cumulative effect of a 1 per cent shock to the terms of trade on the current account for each of the three parsimonious models. The upper impulse response is based on the sample of 10 countries with the least persistent terms of trade, the middle impulse response is

based on the full set of 96 countries, and the lower impulse response function is based on the sample of 11 countries with the most persistent terms of trade. In all cases, the current account rises initially, but this is reversed in subsequent years. The current account quickly moves towards a deficit in the case of countries for which the shock is persistent. This is consistent with a lagged investment effect dominating any consumption-smoothing effect. For countries that experience predominantly temporary terms of trade shocks the consumption-smoothing effect appears to dominate and the current account moves towards a surplus.

Figure 3: Current Account Response to a 1 Per Cent Terms of Trade Shock



Bootstrap techniques were used to provide 95 per cent confidence intervals around each of the impulse response functions. The confidence intervals (shown in Figure A1 in Appendix A) clearly show that after four years the response of the current account to a terms of trade shock was positive for the 10 countries with the least persistent terms of trade and negative for countries with the most persistent terms of trade. Furthermore, the confidence interval for the full set of 96 countries

lies around zero and strictly between estimates for the two extreme persistence groupings after four years.[33]

The standard deviation of the terms of trade shocks across countries was 13.5 and 9 per cent for the most and least persistent terms of trade country groups respectively. The current account response to positive shocks of this size after four years was a fall in the current account balance of almost one percentage point for the most persistent terms of trade countries and a rise in the current account of about half a percentage point for the least persistent group.

5. Conclusion

I consider two alternative explanations for the findings before providing a summary of the main results.

5.1 Tornell and Lane – Voracity Effect

Tornell and Lane (1996a, 1996b) present a model of competing fiscal claimants which under certain circumstances implies that a large positive shock to the terms of trade will lead to an increase in government expenditure sufficient to reduce the current account balance (the argument is symmetric for negative shocks). This 'voracity effect' is an alternative explanation of the finding of a negative relationship between the terms of trade and the current account for some countries.

To control for this potential effect, I re-estimated the panel regression of Equation (10) with the government fiscal balance (as a per cent to GDP) included as a right-hand-side variable:

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[33] In the long run, the path of the current account should satisfy the intertemporal budget constraint and the transversality condition. That is, if the shock causes the current account to increase for a while, eventually the current account should decrease below its original position (and vice versa if the current account decreases following the shock). However, the estimation technique did not include enough lags to account for longer-run behaviour. Adding more lags of the current account to the model provided tentative evidence that in all three cases the current account moves closer towards balance five and six years after the shock.

$$\Delta CA_{it} = \sum_{j=1}^{4} a_j \Delta CA_{it-j} + \sum_{j=0}^{4} b_j \Delta TOT^{S}_{it-j} + \sum_{j=0}^{4} g_j \Delta GDP^{S}_{it-j} + \sum_{j=0}^{1} j_j \Delta GVT_{it-j} + u_{it}, \qquad (10')$$

where: ΔGVT is the demeaned first difference of the government fiscal balance (as a per cent of GDP); see Appendix B for more details. The government fiscal balance will have a direct effect on the current account balance according to the following identity:

$$CA_t \equiv S_t - I_t + (T_t - G_t), \qquad (15)$$

where, S and I are private savings and investment, respectively, T is government revenue, and G is government expenditure. If private savings and investment decisions were independent of the government fiscal position, then $j_0 = 1$ (and $j_1 = 0$) in Equation $(10')$. The lag of ΔGVT in Equation $(10')$ accounts for the problem of government statistics being reported on a fiscal year basis which is often different from calendar years.[34]

An indirect effect of changes in the government fiscal position will exist if private savings and investment adjust to changes in the government fiscal position (this possibility is ignored by Tornell and Lane). Government expenditure may crowd out some private investment. An increase in the government deficit may lead to increased private savings in order to pay for expected future tax increases. These indirect effects work in the opposite direction to the direct effect of the government fiscal balance on the current account. If there is full crowding out and agents are perfectly Ricardian in their behaviour, then $j_0 = 0$, and $j_1 = 0$ (if agents are slow to adjust, then $j_0 + j_1 = 0$).

I ignored the possible endogeneity problem by asserting that any response of the government fiscal balance to current account 'imbalances' was likely to be delayed

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[34] Other lags of the government fiscal balance variable were not included in the regression because they were never significant.

in all but crisis situations. Such episodes were not likely to be the dominant effect across a longer time period and a large sample of countries, as used in this paper.[35]

As the results in Table A1 (in Appendix A) show, there was a negative correlation between the terms of trade and the current account for countries with persistent terms of trade even after controlling for the government fiscal balance. Therefore, the voracity effect is not a convincing alternative explanation of the results of this paper. The effect of the government fiscal balance had the expected sign (although it was significant only for the country group with less persistent terms of trade shocks). The sum of coefficients on government fiscal balance was closer to zero than to one, which suggests a strong indirect effect (that is, private agents offsetting the direct effect of a change in the government fiscal position).

5.2 Credit Constraints

If consumers in a country faced significant credit constraints, the consumption-smoothing effect would be dampened in the case of negative terms of trade shocks. For such countries it is conceivable that the investment effect will dominate the consumption-smoothing effect.[36] However, I argue that the two country groupings (based on terms of trade persistence) face similar degrees of credit constraints for consumers and, therefore, it is not likely that credit constraints are driving the results that I have shown in Section 4.

I used the level of real GDP per capita of a country to proxy the existence of credit constrained consumers. Table 6 below shows that the two country groups have very similar distributions of real GDP per capita (see Appendix B for the exact description of the data). The significance of possible credit constraints seems constant across both high and low terms of trade persistence country groups.

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[35] Endogeneity is not an issue in cases where the government deficit is so high as to imply a balance of payments crisis and, therefore, is reduced either because of the crisis or to avoid a potential crisis.

[36] The existence of credit constrained consumers does not imply that large firms are also credit constrained, so the response of investment will still be the same. For example, many investment projects could be funded by foreign direct investment.

Table 6: Distribution of Real GDP per Capita
1990 US dollars

	Average across group[(a)]	Min. within group	Max. within group	No. in group < 1000	No. in group < 4000	No. in group >10000
11 countries with highest terms of trade persistence	6 236	485	15 631	2	6	3
10 countries with lowest terms of trade persistence	6 424	497	10 959	1	5	4

Note: (a) Indicates country averages taken over the period 1960 to 1992.

5.3 Final Remarks

Theory implies that the response of the current account balance to shocks depends on the degree of persistence of these shocks. The consumption-smoothing effect and the investment effect work in opposite directions. The greater the persistence of a shock, the more the investment effect will dominate. Therefore, in the years following a persistent shock, the current account will move in the opposite direction to the shock. The opposite is true for more temporary shocks. Terms of trade shocks were used to test this theory because they display a wide range of persistence across different countries. This paper has shown strong evidence that the persistence of shocks is an important determinant of the current account in accordance with this simple theory.

An episodic approach using a two-year window to examine large terms of trade changes showed that many countries experience both positive and negative correlations between the terms of trade and the current account. This is not surprising given that it is likely that shocks were neither entirely temporary nor entirely permanent. A stronger finding was developed by using two subsets of countries that lay at extreme ends of the spectrum of terms of trade persistence. Countries with the lowest terms of trade persistence had more episodes of positive correlation and less of negative correlation between the current account and the terms of trade than countries with the highest terms of trade persistence.

Panel-data regressions showed that the current account response is positively related to the terms of trade for countries with predominantly temporary terms of trade

shocks and negatively related for countries with predominantly permanent terms of trade shocks. Moreover, the response of the current account for these two smaller country groups was shown to be significantly different from the response estimated across the full sample of countries.

These results were robust to the inclusion of changes in the government fiscal balance to control for possible ‘voracity effects’ as in Tornell and Lane (1996a, 1996b). Also, the findings do not appear to be related to the existence of credit constraints because both of the country groupings based on terms of trade persistence have very similar distributions of per capita income (across countries).

Appendix A: Further Results

A.1 Correlation Episodes and Terms of Trade Persistence

Table A1: Summary of Country Correlations Episodes and TOT Persistence

Country	Correlation of CA_t with		Episodes from Table 2 correlations			Data exists	ADF $\hat{r}_i$, $(p = 3)$	
	TOT_t	TOT_{t-1}	positive	zero	negative	'70–'92	Trend & constant	Constant only
Average/Sum	0.21	-0.15	516	1120	240		0.68	0.84
Algeria	0.57	-0.44	5	2	0	yes	0.89	0.92
Antigua & Barbuda	0.04	-0.28	1	16	2		0.64	0.67
Argentina	-0.12	0.13	9	10	6	yes	0.75	0.97
Australia	0.13	-0.40	3	6	5	yes	0.47	0.98
Austria	0.24	-0.17	6	11	0	yes	0.75	0.91
Bahamas, The	-0.06	0.62	2	14	4		0.79	0.78
Bahrain	0.13	0.20	3	9	3		0.78	0.78
Bangladesh	0.16	0.07	1	15	3	'71–'92	0.31	0.86
Barbados	0.28	-0.21	3	6	2	yes	0.64	0.92
Belgium	0.49	-0.21	9	3	0	yes	0.76	0.94
Bolivia	0.44	-0.49	4	9	0	yes	0.97	0.86
Botswana	0.00	-0.09	0	4	3	'71–'92	0.91	0.86
Brazil	0.13	0.02	9	10	2	yes	0.54	0.77
Bulgaria	0.87	-0.19	3	0	0			
Burkina Faso	0.31	-0.02	5	11	1	yes	0.68	0.94
Burundi	0.59	-0.04	7	10	0	'71–'92	0.54	0.87
Cameroon	0.37	-0.31	8	8	0	'71–'92	0.73	0.74
Canada	-0.03	-0.27	3	11	5	yes	0.85	0.94
Cape Verde	0.44	-0.36	4	11	0		0.63	0.91
Centrl. African Rep.	0.12	-0.21	4	6	1	yes	0.71	0.71
Chad	0.08	0.06	3	13	1	yes	0.61	0.93
Chile	0.49	-0.19	7	11	1	yes	0.79	0.95
China	0.24	0.00	6	13	0	'71–'92	0.69	0.71

Table A1: Summary of Country Correlations Episodes and TOT Persistence
(continued)

Country	Correlation of CA_t with		Episodes from Table 2 correlations			Data exists	ADF $\hat{r}_i$, $(p = 3)$	
	TOT_t	TOT_{t-1}	positive	zero	negative	'70–'92	Trend & constant	Constant only
Colombia	0.22	-0.06	4	5	2	yes	0.89	0.83
Costa Rica	0.35	-0.31	6	15	2	yes	0.07	0.91
Cote d'Ivoire	0.39	-0.38	7	9	2	yes	0.81	0.79
Cyprus	-0.06	-0.11	5	12	3	yes	0.79	0.99
Denmark	0.29	-0.31	5	6	1	yes	0.80	0.86
Dominica	-0.27	-0.19	0	10	4		0.78	0.91
Dominican Republic	0.33	0.02	5	8	2	yes	0.30	0.59
Ecuador	0.18	-0.26	4	3	0	yes	0.88	0.92
Egypt, Arab Rep.	-0.15	-0.22	2	5	3	yes	0.66	0.78
El Salvador	0.47	-0.41	5	8	0	yes	0.79	1.02
Equatorial Guinea	0.06	-0.09	5	10	0		0.10	0.11
Ethiopia	-0.14	-0.03	3	9	2	yes	0.60	0.93
Fiji	0.40	-0.37	2	8	2	yes	0.69	0.84
Finland	-0.31	-0.05	2	9	10	yes	0.64	0.63
France	0.58	-0.46	6	3	0	yes	0.75	0.75
Gabon	0.67	-0.28	4	3	0	yes	0.83	0.91
Gambia, The	0.29	-0.10	4	14	2	'71–'92	0.52	0.86
Germany	0.15	-0.06	5	8	2	yes	0.74	0.75
Ghana	0.07	-0.02	2	11	4	yes	0.81	0.83
Greece	-0.22	0.23	3	14	3	yes	0.59	0.92
Grenada	0.05	-0.21	2	14	2		0.82	0.99
Guatemala	0.57	-0.54	5	10	0	yes	0.65	1.01
Guinea	0.31	-0.52	0	16	0		0.81	0.93
Guyana	0.38	-0.24	3	8	0	yes	0.49	0.81
Haiti	0.48	-0.15	9	8	1	yes	0.39	1.03
Honduras	-0.03	-0.02	2	9	8	yes	0.31	1.09
Hong Kong	0.40	-0.29	8	12	2		0.82	1.04
Hungary	-0.09	0.04	4	4	3		0.76	0.94

Table A1: Summary of Country Correlations Episodes and TOT Persistence
(continued)

Country	Correlation of CA_t with		Episodes from Table 2 correlations			Data exists	ADF $\hat{r}_i$, ($p = 3$)	
	TOT_t	TOT_{t-1}	positive	zero	negative	'70–'92	Trend & constant	Constant only
Iceland	0.09	-0.47	6	17	2	yes	0.70	0.73
India	0.09	0.02	5	8	3	yes	0.77	0.92
Indonesia	0.38	-0.48	5	1	1	yes	0.87	0.91
Iran, Islamic Rep.	0.55	-0.44	2	3	2	yes	0.85	0.91
Iraq	0.65	-0.32	1	6	0		0.84	0.92
Ireland	0.30	-0.52	5	9	0	yes	0.58	0.63
Israel	0.26	0.02	5	8	1	yes	0.64	0.63
Italy	0.58	-0.23	7	5	0	yes	0.88	0.87
Jamaica	0.20	-0.44	4	4	1	yes	0.38	0.44
Japan	0.39	-0.39	8	8	0	yes	0.89	0.84
Jordan	-0.04	0.11	2	5	2	yes	0.53	0.65
Kenya	0.21	-0.43	6	3	4	yes	0.93	0.94
Korea, Republic of	0.48	-0.19	10	3	3	yes	0.73	0.74
Kuwait	0.11	-0.15	0	7	0		0.86	0.92
Lebanon	0.23	0.49	0	11	0		0.63	0.87
Liberia	-0.14	-0.17	5	15	2		0.73	0.90
Libya	0.39	-0.44	4	1	2		0.85	0.91
Madagascar	0.05	0.29	0	14	4		0.67	0.85
Malawi	0.20	-0.39	5	14	1	yes	0.24	0.76
Malaysia	0.31	-0.68	0	15	0		0.75	0.77
Mali	0.26	0.24	7	12	2	yes	0.19	0.36
Malta	0.22	-0.11	5	7	5	yes	0.89	0.83
Mauritania	-0.29	-0.02	2	7	6	yes	0.80	0.95
Mauritius	0.46	-0.33	5	8	0	yes	0.64	0.64
Mexico	-0.03	-0.23	2	7	0	yes	0.82	0.84
Morocco	0.04	-0.60	1	1	4	yes	0.37	0.61
Mozambique	0.32	0.17	3	14	0		0.41	0.43
Namibia	0.15	0.32	2	13	0		0.38	0.83

Table A1: Summary of Country Correlations Episodes and TOT Persistence
(continued)

Country	Correlation of CA_t with		Episodes from Table 2 correlations			Data exists	ADF $\hat{r}_i$, $(p = 3)$	
	TOT_t	TOT_{t-1}	positive	zero	negative	'70–'92	Trend & constant	Constant only
Netherlands	0.22	-0.14	6	10	2	yes	0.82	0.90
Netherlands Antilles	0.61	0.47	2	21	0		0.86	0.87
New Zealand	0.20	-0.50	7	11	0	yes	0.61	0.75
Nicaragua	-0.11	-0.08	2	12	2	yes	0.71	0.98
Niger	-0.40	0.48	0	12	5	yes	0.63	0.94
Nigeria	0.55	-0.51	4	5	2	yes	0.90	0.91
Norway	0.59	0.00	8	6	0	yes	0.80	0.83
Oman	0.72	-0.52	2	2	0		0.87	0.87
Pakistan	-0.24	0.25	2	8	2	yes	0.72	1.00
Panama	-0.20	0.24	2	14	2	yes	0.84	0.81
Papua New Guinea	0.63	-0.05	9	12	0	'71–'92	0.10	0.80
Paraguay	0.58	0.18	4	17	0	yes	0.40	0.89
Peru	0.08	-0.33	5	18	5	yes	0.80	0.96
Philippines	-0.18	-0.33	2	9	3	yes	0.68	0.87
Poland	-0.14	0.84	2	12	1		0.36	0.55
Portugal	0.29	-0.42	9	8	2	'71–'92	0.22	0.95
Qatar	0.58	-0.53	3	3	0		0.83	0.91
Rwanda	0.16	-0.31	3	5	1	yes	0.78	0.87
St. Kitts and Nevis	0.23	0.49	4	15	0		0.84	0.83
St. Lucia	-0.10	-0.25	2	13	2		0.77	0.76
Saudi Arabia	0.72	-0.34	4	2	0	yes	0.84	0.92
Senegal	0.25	0.08	4	3	2	yes	0.72	0.77
Sierra Leone	0.13	-0.24	5	12	4	yes	0.04	0.98
Singapore	-0.10	0.12	6	4	2	yes	0.73	0.86
Solomon Islands	-0.42	-0.19	0	7	5		0.68	0.85
South Africa	-0.09	-0.29	7	10	6	yes	0.86	0.98
Spain	0.24	-0.37	6	12	6	yes	0.87	0.89
Sri Lanka	0.54	-0.24	9	6	0	yes	0.36	0.67

Table A1: Summary of Country Correlations Episodes and TOT Persistence
(continued)

Country	Correlation of CA_t with		Episodes from Table 2 correlations			Data exists	ADF $\hat{r}_i$, $(p = 3)$	
	TOT_t	TOT_{t-1}	positive	zero	negative	'70–'92	Trend & constant	Constant only
Sudan	0.34	0.11	2	8	0	yes	0.38	0.97
Swaziland	0.41	0.24	2	5	0		0.61	0.65
Sweden	0.28	-0.19	3	5	1	yes	0.82	0.83
Switzerland	0.12	-0.10	6	4	6	yes	1.10	0.81
Syrian Arab Rep.	-0.25	-0.24	0	7	3	'70–'91	0.85	0.93
Tanzania	0.12	-0.57	5	6	3	yes	0.93	1.09
Thailand	-0.31	0.12	0	13	2	yes	0.26	0.89
Tonga	-0.39	0.01	0	10	2		0.67	0.82
Trinidad & Tobago	0.49	-0.20	5	7	1	yes	0.85	0.87
Tunisia	0.12	-0.38	0	10	0	yes	0.80	0.90
Turkey	0.33	-0.06	4	9	2	yes	0.82	0.88
Uganda	0.24	-0.28	7	6	2	yes	0.74	0.82
United Arab Emrts.	0.87	-0.32	6	1	0		0.85	0.90
United Kingdom	0.53	0.06	5	6	0	yes	0.67	0.66
United States	0.01	-0.58	0	7	9	yes	0.85	0.93
Uruguay	0.18	-0.21	5	5	3	yes	0.53	0.78
Venezuela	0.58	-0.34	6	1	0	yes	0.82	0.89
Western Samoa	-0.06	-0.22	2	11	2		0.64	0.79
Zaire	-0.12	0.26	2	16	3		0.72	0.96
Zambia	0.72	-0.35	10	13	0	yes	0.72	0.91
Zimbabwe	-0.08	-0.19	3	15	3	'71–'92	0.53	0.95

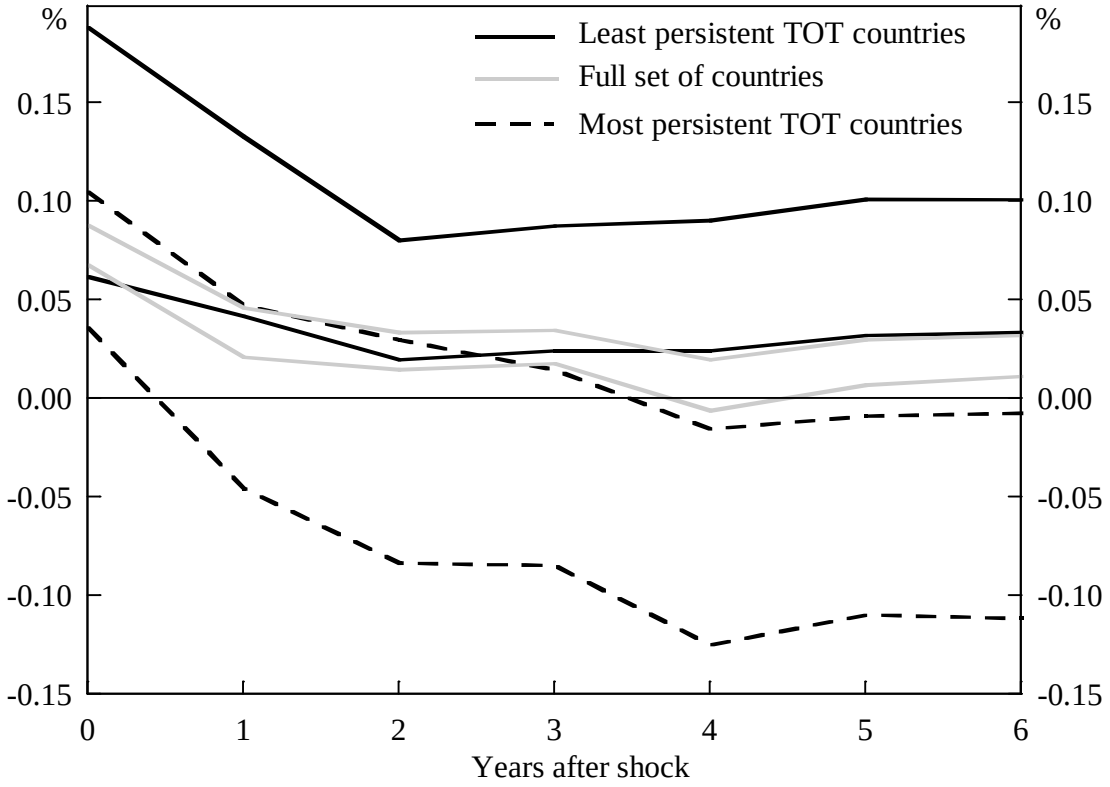
A.2 Impulse Response Functions: Confidence Intervals

Confidence intervals around impulse response functions (discussed at the end of Section 4.4) were estimated by using a bootstrap technique. For each model estimated, new current account data was created by assuming the original model estimate to be true and generating errors from an independently identically distributed normal distribution with a mean of zero and a variance estimated from

the original error estimates. New estimates of the model were produced using this new current account series, and from this a new impulse response function was constructed. This procedure was repeated one thousand times. A 95 per cent confidence interval was constructed by eliminating the upper 25 and lower 25 extreme impulse responses point by point along the impulse response function.[37]

Figure A2: Current Account Response to a 1 Per Cent Terms of Trade Shock

95 per cent confidence interval



[37] The alternative was to construct a metric that estimated the distance of the impulse response functions from the initial estimate of the function and then eliminate extreme functions to create a confidence interval.

A.3 Panel-data Results Including Government Fiscal Balances

Table A2: Panel Data FGLS – Highest versus Lowest TOT Persistence

Dependent variable – *DCA*, period of estimation – 1970 to 1992

		11 countries with highest TOT persistence		9 countries with lowest TOT persistence[a]	
		Full model[b]	Parsimonious model	Full model[b]	Parsimonious model[b]
Variable	Lag	Coefficient (t-statistics)			
ΔCA	1	-0.252 (-3.02)	-0.192 (-2.61)	-0.322 (-3.91)	-0.398 (-2.97)
	2	-0.138 (-2.08)	–	-0.379 (-5.35)	-0.428 (-5.71)
	3	-0.206 (-3.58)	-0.182 (-3.66)	-0.114 (-1.94)	-0.126 (-2.33)
	4	-0.096 (-1.56)	–	-0.167 (-2.54)	-0.166 (-2.75)
ΔTOT^S	0	0.061 (2.19)	0.060 (2.11)	0.137 (2.81)	0.134 (2.77)
	1	-0.049 (-1.83)	-0.053 (-2.07)	0.001 (0.01)	–
	2	-0.037 (-1.78)	-0.043 (-2.41)	-0.001 (-0.04)	–
	3	-0.009 (-0.51)	–	0.009 (0.18)	–
	4	-0.055 (-2.67)	-0.047 (-2.08)	0.010 (0.32)	–
ΔGDP^S	0	-0.199 (-3.79)	-0.205 (-3.94)	-0.161 (-2.06)	-0.161 (-2.09)
	1	-0.019 (-0.47)	–	-0.169 (-2.15)	-0.195 (-2.29)
	2	-0.028 (-0.62)	–	-0.108 (-1.89)	-0.201 (-1.98)
	3	0.020 (0.51)	–	-0.046 (-0.54)	–
	4	0.028 (0.74)	–	0.030 (0.37)	–
ΔGVT	0	0.112 (1.58)	0.100 (1.55)	0.189 (2.04)	0.229 (2.38)
	1	-0.008 (-0.12)	–	0.063 (0.69)	–
$\sum_{j=0}^{4} \Delta TOT^s_{t-j}$		-0.087 (-2.10)	-0.083 (-2.50)	0.155 (1.71)	0.134 (2.77)
$\sum_{j=0}^{4} \Delta GDP^s_{t-j}$		-0.198 (-1.78)	-0.205 (-3.94)	-0.454 (-2.10)	-0.556 (-3.36)
$\sum_{j=0}^{1} \Delta GVT_{t-j}$		0.104 (0.84)	0.100 (1.55)	0.252 (1.83)	0.229 (2.38)
		No. Obs 209	No. Obs 209	No. Obs 171	No. Obs 171
		$R^2 = 0.38$	$R^2 = 0.35$	$R^2 = 0.47$	$R^2 = 0.39$

Notes: (a) Jamaica is excluded because it is missing a lot of GVT data.

(b) Indicates standard errors corrected for heteroskedasticity and for serial correlation.

Appendix B: Data

The data sources used in this paper include: the IMF's *International Financial Statistics* (March and June 1996 CDROM versions); the World Bank's databases (both the 1994 and the 1995 CDROM versions); the Summers and Heston database in the Mark 5.6 version of the Penn World Tables; and the OECD *National Accounts* and *Yearbook of Employment Statistics*. For each series, I provide a brief discussion of the main issues and outline the rule used to construct the preferred measure from the various data sources. It is beyond the scope of this paper to provide details on every component of the data (see the original sources for more information). There were exceptions to these rules when data was lacking from the preferred source for individual countries; it was often necessary to splice together data from different sources to get extensive coverage across countries and across time. A detailed list of the exceptions to the rules, and the reasons for these exceptions, is available on request. Also, many obvious errors in original data were identified and corrected using graphical techniques.

Current account balance

As a rule I used the IFS (line '78ald') for the current account balance (recorded in US dollars). When this data was missing, I used World Bank data (1995 CDROM, BN CAB FUND CD, current account balance after official transfers, US dollars, balance of payments basis).

Terms of trade

There are two main sources for the terms of trade – the IFS (by combining unit values '74…' and '75…' or price indices '74..d' and '75..d') and the 1995 World Bank CDROM (terms of trade index, 1987=100, TT PRI MRCH XD). Prior to 1995, the World Bank published terms of trade series that had been estimated in house. In 1995, they began to use the UNCTAD's database for the terms of trade.

The World Bank essentially uses the IFS data for the developed countries. However, prior to the 1995 CDROM, they constructed their own estimates for developing countries based mainly on commodity prices. The most obvious difference is the extra weight given to the price of oil for many of these countries because of the exclusion of the prices of manufactures and services. The oil shocks

are more apparent in the World Bank 1994 database than in the World Bank 1995 or the IFS databases.

For the terms of trade I tried to use the WB95 data where possible. This was the preferred source because it generally provided better coverage historically and across a broader range of countries. The WB95 data were similar to the IFS for developed countries. The WB94 database was not so useful because it will no longer be available in the future and for developing countries it was based mainly on commodity prices, ignoring manufactures and services.

Trade shares

Individual country trade shares were used to weight the terms of trade of each country, although these results are not reported in the paper. I used the measure of openness provided in the PWT5.6: variable 25, Openness, which is the ratio of the sum of imports and exports to GDP in national currencies. In order to avoid introducing extra noise from short term variation in openness, I took a nine-year centred moving average of the trade shares before applying them to the terms of trade. (The moving average was truncated at the end points of the sample.) This still allowed for long term variation in countries' openness.

Nominal GDP

Nominal GDP was needed to construct current account and government fiscal balances as a ratio to GDP.

Nominal GDP in local currency

The two sources used were the IFS (line '99b..' or '99b.c') and the World Bank (1995 CD ROM – GDP at market prices, local currency, *NY GDP MKTP CN*). Much of the WB95 database, especially for developed countries, comes from the IFS. As a rule the IFS was the preferred source, providing the best coverage historically and most reliable in terms of revisions. (Although, the two sources are very close for most countries.)

Exchange rates

The current account balance is recorded in US dollars. In order to construct the ratio of the current account to GDP, nominal GDP in local currencies had to be converted using the exchange rate. In some cases the official exchange rates published by the IMF in the IFS (line 'rf') do not reflect the same international prices that are automatically incorporated into the current account data (almost all countries for which this was a problem are invoiced in US dollars for international transactions). To account for this, I used the World Bank's 'Atlas' exchange rate series. These rates are generally based on the official IFS reported rates. Exceptions arise when multiple exchange rates are averaged or when official exchange rates are fixed far from free market levels (for more information refer to the World Tables publication).

I used the IFS exchange rates when the WB95 did not provide the data – primarily in the most recent years in the sample. The only problematic country was Uganda. The official exchange rate (from the IFS) was clearly inappropriate for the late 1970s and early 1980s because it implies implausibly large GDP growth rates (in US dollar terms). So for Uganda, I used the IFS official exchange rate, except for the years 1977–81 for which I took a linear interpolation of nominal GDP in US dollars.

Real GDP

Real GDP was taken mostly from the PWT5.6: variable 2, RGDPCH, real GDP per capita in constant dollars (Chain index, expressed in international prices, base 1985). This was converted to real GDP using the population variable. This data was supplemented by the World Bank 1995 (NY GDP MKTP KD) and the IFS data (line '99b.r' or '99b.p') – mostly to make series as current as possible. As a rule, I used the PWT5.6 data supplemented by the WB95 data (notice that WB95 data is equivalent to IFS data for the developed countries).

Government fiscal balance

The primary data source for the government fiscal balance was the IFS. I had to supplement this with data from the World Bank 1995 and 1994 CDROMs[38] and the hard copy of the IMF's *Government Financial Statistics* (GFS, 1995).

Solow residuals for OECD countries

Solow residuals were constructed from a Cobb-Douglas production function:

$$\hat{A}_{it} = \hat{Y}_{it} - d\hat{L}_{it} - (1-d)\hat{K}_{it}, \qquad \text{(B1)}$$

where, $\hat{A}_{it}$ is the Solow residual for country i at time t, Y is real GDP, L is employment, K is the capital stock and d is the share of labour in output. A 'hat' over a variable represents the percentage change on the previous year.

Employment data was kindly provided by Aart Kray and comes from Kray and Ventura (1996). The employment data comes originally from the OECD *Yearbook of Employment Statistics* and is the total civilian employment. The labour share of output data was originally from the OECD *National Accounts* (it was constructed as the ratio of compensation of employees, MOCOM, to gross domestic expenditure, MOGDPE, both in current local currency units).

Data on the capital stock was taken from the PWT5.6 – variable number 20, KAPW, non-residential capital stock per worker (1985 international prices). This was converted to the level of the capital stock by constructing a series of the number of workers from the real GDP per worker series (number 19, RGDPW) and real GDP (see above).

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[38] The WB94 database contains some data on the government fiscal balance that is not in the WB95 database; otherwise, they are very similar. The WB94 CDROM was used more often than the WB95 CDROM for this variable – but it should make little difference.

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