OPENNESS AND THE SECTORAL EFFECTS OF FISCAL POLICY

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Abstract
Based on structural VAR evidence for the U.S., we document that a rise in government spending generates three facts: (1) an appreciation of the terms of trade; (2) a fall in the price of traded vs. non-traded goods (proxied by the price of goods relative to services), and (3) a positive co-movement between the manufacturing and the service sector, both in consumption and production. We show that, even if government spending is assumed to be as intensive in goods and services as households' consumption, the relative price behavior can be explained as a simple implication of trade openness. However, a baseline open-economy business-cycle model has problems in rationalizing simultaneously the sectoral co-movement of quantities and the behavior of relative prices. This anomaly is enhanced if government spending is assumed to be intensive in non-traded goods. (JEL: E52, F41, E62)

1. Introduction

In this article we study, both empirically and theoretically, the effects of a shock to government spending (on goods and services) on the terms of trade and the relative price of traded versus non-traded goods. Based on structural VAR evidence, we find that a rise in government spending generates an appreciation of the terms of trade and a fall in the price of goods relative to services (our empirical measure of the relative price of traded goods).

A long tradition in international macroeconomics (see, e.g., Frankel and Razin 1992) has argued that a shock to government spending on goods and services tends to appreciate the relative price of non-traded goods: The key mechanism in this tradition is that government spending is considered to be intensive in services, which are typically thought of as non-traded, or less tradable than (manufactured) goods. Thus, in this class of models, government spending shocks are essentially *sectoral* shocks.

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TABLE 1. Average shares of spending on goods and services, 1954:1–2006:2.

	Private	Government	Government, Excluding Wages
Spending on goods in GDP	0.32	0.035	0.035
Spending on services in GDP	0.32	0.14	0.037
Services in total spending on goods and services	0.49	0.80	0.52

In the data, however, government spending is more intensive in services only if its measure includes the compensation of public employees. Table 1 displays the shares of goods and services, respectively, in GDP and in total spending on the two items, for the private sector and the government, over the periods 1954:1–2006:2.[1] Clearly, government spending is much more intensive in services than private consumption. However, if one includes in the definition of services purchased by the government only intermediate services, and excludes the compensation of government employees, the shares of services in total spending are roughly equal in the two sectors, at about 0.5.

To study the effects of government spending shocks theoretically, we build a two-sector open economy business-cycle model with monopolistic pricing in the intermediate production stage. We show that, even if government spending shocks have the same service intensity as private spending, a terms of trade appreciation and a fall in the relative price of traded goods can be rationalized as a consequence of trade openness. We then look at the behavior of production and consumption of goods and services, and show that a baseline model relying on the wealth effect of government spending and perfect risk-sharing across countries has problems rationalizing simultaneously the sectoral co-movement of quantities and the behavior of relative prices, and especially so if government spending is considered intensive in non-traded goods.

2. Empirical Evidence

We use U.S. data.[2] The sample is 1954:1–2006:2. The baseline structural vector autoregression (SVAR) incudes the following variables: government spending on goods and services, net taxes (i.e., revenues less transfers), GDP, production of goods, production of services, private investment, the three-month interest rate on Treasury bills, and the price of goods relative to services (relative price of traded

1. Government spending on goods includes defense spending on equipment and software, but excludes the rest of government investment.

2. The source of all variables is the NIPA accounts, except for the interest rate, which is from the St. Louis Fed database.

goods). The quantity variables enter the SVAR in logs of real, per capita values; the relative price of traded goods is expressed in logs. Government spending is defined as government consumption (which includes the consumption of intermediate goods and services and the compensation of government employees) plus defense spending on equipment and software (which appears as investment in the U.S. national accounts but is considered consumption by international government accounting rules).

Figure 1 displays our baseline results. The initial shock to government spending is equal to 1% of GDP. The responses of real quantities are expressed in percentage points of GDP by multiplying the original log response by the average share of that variable in GDP. The figure also displays one standard error band (computed via Monte Carlo simulations) on the two sides of the impulse responses. The government spending shock is identified via the methodology first developed in Blanchard and Perotti (2002), and later applied, for example, in Monacelli and Perotti (2006, MP 06 henceforth) and Perotti (2007). The identification approach essentially consists in subtracting the endogenous component

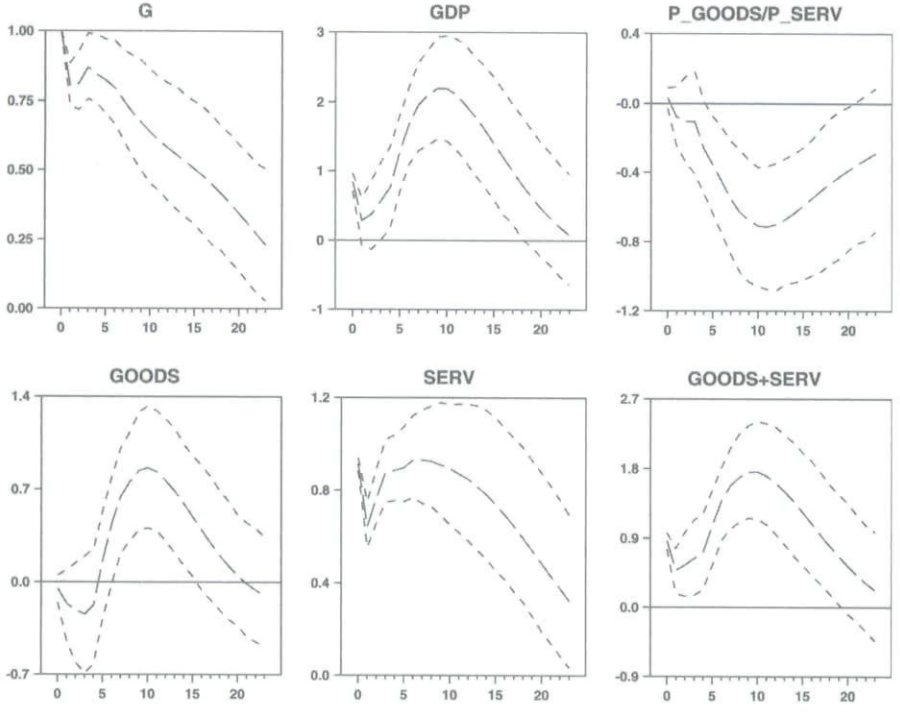

FIGURE 1. Responses of government spending, GDP, relative price of traded goods, production of goods, production of services, and aggregate production to a structural government spending shock. See text for SVAR specification, sample 1954:1–2006:2.

of the reduced form government spending and tax residuals, using elasticities to GDP provided by the OECD.

The main finding is that, in response to an identified government spending shock, the production of both goods and services increases, and the relative price of traded goods declines, by a maximum of about 1% after 1 year. We also computed responses from a similar VAR specification (not shown), simply replacing the relative price of traded goods with the *terms of trade* (relative price of imports). Importantly, we find that the terms of trade appreciate (i.e., the relative price of imports falls), by a maximum of about 3% after about two years. Finally, we computed responses from a VAR in which the production of goods and services is replaced by the *consumption* of goods and services. As for production, we find that the data display also a positive sectoral co-movement in consumption.[3]

To summarize, our empirical analysis delivers three basic results. In response to a rise in government spending: (1) the relative price of traded goods (proxied by the price of goods relative to services) falls; (2) the terms of trade appreciate (the relative price of imports falls); (3) output and consumption rise in both sectors (positive sectoral co-movement).

The evidence illustrated above raises a series of issues. For one, the relative price behavior from (1) and (2) may be intuitive if government spending is considered intensive in services, so that spending shocks are essentially sectoral shocks. In this case, however, it is difficult to rationalize the sectoral co-movement in quantities (fact 3). On the other hand, if one were not to include public wages in the measure of government spending (as is often done in many models in the literature), government spending shocks should be considered essentially symmetric across sectors (see Table 1). In that case, by contrast, it would be intuitive to rationalize the observed sectoral co-movement, but it would be difficult to account for the behavior of relative prices.

3. The Model

We analyze these issues in a small open economy[4] with two competitive final good sectors, producing traded and non-traded goods, respectively. Within each sector, monopolistic competitive intermediate goods firms produce a continuum of differentiated varieties. A share of the traded goods α consumed by the domestic agent is imported from abroad. The details of the model are described in the Appendix.[5] The government allocates consumption in a way similar to consumers.

3. The fact that consumption rises in both sectors reinforces the findings of a recent literature documenting a positive response of aggregate consumption to government spending shocks (see Perotti 2007)

4. Thus we abstract, for simplicity, from international spillover effects.

5. The Appendix describing the model is available at www.igier.uni-bocconi.it/monacelli.

Hence a government agency collects bundles of traded and non-traded goods to produce the final government good

$$G_t = \left[(1-\omega)^{\frac{1}{\rho}} G_{N,t}^{\frac{\rho-1}{\rho}} + \omega^{\frac{1}{\rho}} G_{T,t}^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}},$$

where $\rho > 0$ is the elasticity of substitution between traded and non-traded bundles of goods, and ω is the share of traded goods in final consumption. Maximization of profits implies the following government's demand functions for traded and non-traded bundles

$$G_{T,t} = \omega(P_{T,t}/P_t)^{-\rho} G_t \quad \text{and} \quad G_{N,t} = (1-\omega)(P_{N,t}/P_t)^{-\rho} G_t;$$

in turn $G_{T,t}$ is allocated optimally between domestic and imported goods according to

$$G_{h,t} = (1-\alpha)(P_{h,t}/P_{T,t})^{-\eta} G_{T,t},$$
$$G_{f,t} = \alpha(P_{f,t}/P_{T,t})^{-\eta} G_{T,t}.$$

4. Dynamic Simulations

We now show that the sectoral behavior of relative prices that we identify in the data can be rationalized as a consequence of trade openness. In other words, both fact (1) and (2) can be obtained even in the case in which government spending is as intensive in traded and non-traded goods as households' consumption. However, we show that the behavior of sectoral quantities (fact 3) is much more difficult to rationalize.

4.1. Best Quantity Scenario

We define by "best quantity scenario" the one in which government spending is as intensive in traded and non-traded goods as households' consumption. In principle, this should be the most favorable scenario to induce positive co-movement in sectoral quantities, and the least favorable to generate the correct relative price behavior. However, although the latter can be rationalized as a natural implication of trade openness, the quantity behavior is instead more problematic, at least in a standard model.

Figure 2 depicts the effect of a 1% rise in aggregate government spending for alternative values of the trade openness parameter.[6] Prices are assumed to be

6. We assume an AR(1) process for (log) government spending, with an autoregressive parameter of 0.85 in quarterly data (see MP 06).

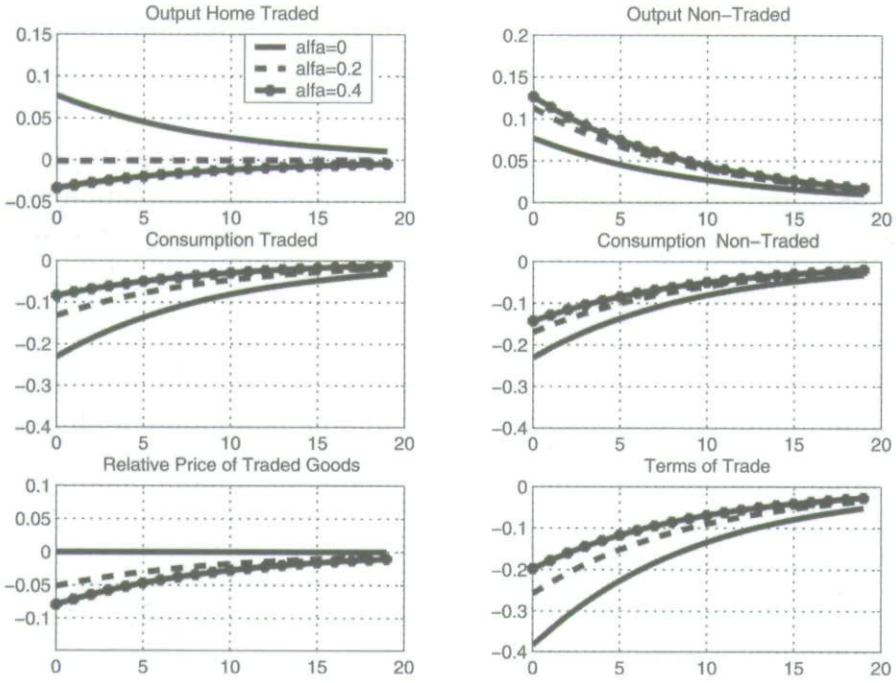

FIGURE 2. Model responses to a shock to aggregate government spending (flexible prices in both sectors, $\eta = 1.5$, $\omega = 0.44$).

perfectly flexible in both sectors. Consider first the case $\alpha = 0$ (recall that α is the share of imported tradable goods in final consumption).[7] Notice that the relative price of traded goods remains constant, an implication of price flexibility (i.e., constant real marginal cost) coupled with perfect labor mobility across sectors (which in turn implies a common nominal wage rate). To see that, notice that by imposing a constant marginal cost in both sectors one can show (see Appendix) that $q_t - \alpha s_t = 0$, where q_t is the relative price of traded goods and s_t denotes the terms of trade (relative price of imports), all in logs. Hence, for any values of ω, $\alpha \to 0$ implies $q_t \to 0$ for all t.

Consider now the effect of trade openness ($\alpha > 0$). In this case, the appreciation of the terms of trade (relative price of imports) generates also a fall in the relative price of traded goods. Despite price flexibility, then, the terms of trade appreciation per se induces also a fall in the relative price of traded goods, in line with what observed in the data. Hence, even in the presence of a symmetric rise

7. In this simulation we set $\rho = 0.74$, following Mendoza (1995); $\omega = 0.44$, following Dotsey and Duarte (2007); and the elasticity of substitution between domestic and imported tradable goods $\eta = 1.5$.

in government spending in the two sectors, movements in relative prices (terms of trade and relative price of traded goods) have the correct sign when confronted with our empirical evidence (facts 1 and 2).

Next we analyze the implications for sectoral co-movement. Recall that, in the data, consumption and production expand in both sectors in response to a fiscal expansion. The model, however, has problems generating that pattern. Consumption, in fact, falls both at the aggregate level as well as in both sectors (for any value of α). Thus the sectoral co-movement in consumption is positive, but the response of consumption in either sector has the wrong sign. In general, and not surprisingly, the fall in consumption is a result of the negative wealth effect on households' labor supply induced by the expansion in government spending (see MP 06 for an extensive analysis on this point).

As for production, the model reproduces a correct sectoral co-movement only in the case $\alpha = 0$ (as a consequence of the symmetry of the shock). With openness ($\alpha > 0$), the terms of trade appreciation induces a switching of consumption expenditure towards foreign goods (this effect was absent in the case $\alpha = 0$). In turn, this dampens the expansion in output in the tradable sector (with this effect intensifying with α). Under our chosen value for the elasticity of substitution $\eta = 1.5$ (which is common in the macro literature), the expenditure switching effect prevails, thereby generating a contraction in the traded sector.[8] Interestingly, openness seems to generate a tradeoff between generating the correct behavior in relative prices and generating the correct sectoral co-movement in production.

4.2. Best Relative-Price Scenario

Notice that the issue of sectoral co-movement is even more problematic than it may first appear. So far, in fact, we have assumed symmetry of the government spending shock. Suppose instead that we were emphasizing more strongly that the sectoral composition of government spending is indeed biased towards non-traded goods (services). (As argued previously, however, this argument is not clear a priori, and depends on whether the compensation of government employees is included in the measure of public consumption of services.) Under this scenario, that we label "best relative-price scenario," a government spending shock would—by construction—take the form of an asymmetric demand shock in the non-traded (NT) sector. Figure 3 illustrates this point. As expected, a sectoral shock in the NT sector generates (correctly) a fall in the relative price of traded goods, but also

8. For low values of the elasticity of substitution η, and in general smaller than 1, it is feasible to generate a positive co-movement in production in response to the shock. However, values between 1 and 2 are considered to be more realistic empirically for macroeconomic models. The literature lacks a consensus on the appropriate value of this parameter (see MP 06 for a brief review of the literature).

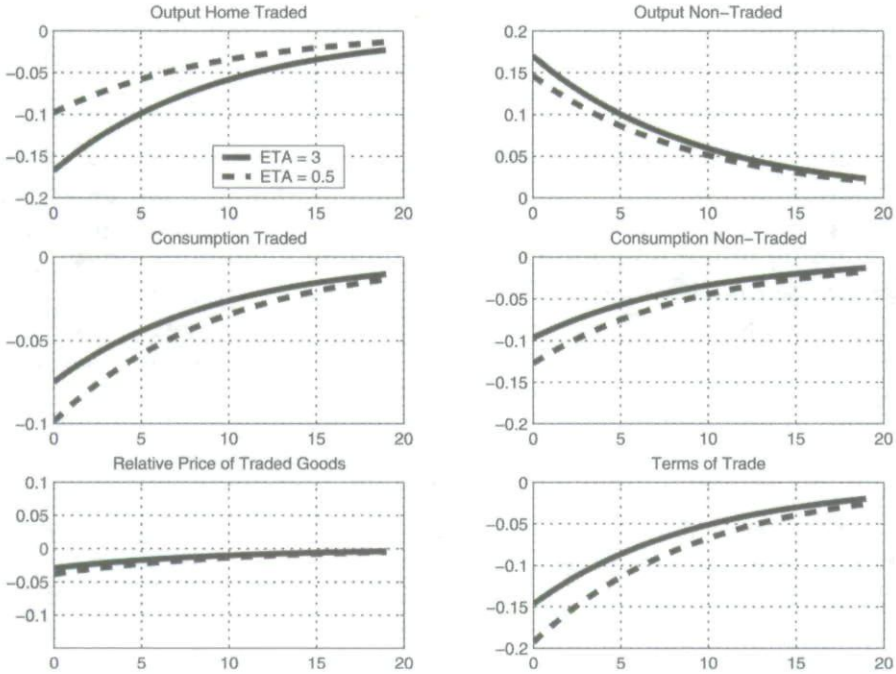

FIGURE 3. Model responses to a shock to government spending in the NT sector (flexible prices in both sectors, $\alpha = 0.2$, $\omega = 0.44$).

a reallocation of employment from the traded to the non-traded goods sector, and hence a negative co-movement in production. Importantly, this holds regardless of whether η is high or low, and (not shown) regardless of whether non-traded goods prices are assumed to be sticky.

4.3. Asymmetry in Price Stickiness

The literature often assumes that non-traded goods prices are more sticky than traded goods prices.[9] Hence we have also analyzed the implications of asymmetry in sectoral price stickiness, and its interaction with openness (simulations not shown). We assumed a four-quarter stickiness in the non-traded sector only. We found that, already for a mild degree of openness, and despite the shock being symmetric in the two sectors, asymmetry in price stickiness intensifies the sectoral co-movement problem: production of non-traded goods rises, whereas production

9. However, recent micro studies on the frequency of price adjustment in the U.S., such as Bils and Klenow (2004) and Nakamura and Steinsson (2007), do not find that the prices of services are systematically more sticky than the prices of goods.

of traded goods falls even more than under flexible prices, due to a strengthening of the terms of trade appreciation effect. In general, investigating whether, in response to government spending shocks, output and employment tend to expand more in sectors in which the frequency of price adjustment is estimated to be lower is an interesting topic for future research.

5. Conclusions

We have modeled and estimated the responses to a government spending shock of the terms of trade, the relative price on non-tradables, and the production and consumption of goods and services. The response of the relative prices are consistent with the model, but a general implication of our analysis is that matching simultaneously the responses of relative prices and sectoral quantities observed in the data may be a problematic challenge for open economy models of the recent literature.

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