Fiscal Policy, Profits, and Investment

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This paper evaluates the effects of fiscal policy on investment using a panel of OECD countries. We find a sizeable negative effect of public spending—and in particular of its wage component—on profits and on business investment. This result is consistent with different theoretical models in which government employment creates wage pressure for the private sector. Various types of taxes also have negative effects on profits, but, interestingly, the effects of government spending on investment are larger than those of taxes. Our results can explain the so-called "non-Keynesian" (i.e., expansionary) effects of fiscal adjustments. (*JEL* E22, E62)

After the fiscal profligacy of the seventies and eighties, several OECD countries have stabilized and reduced their debt to GDP ratios by means of large fiscal adjustments. In contrast to the prediction of standard models driven by aggregate demand, many fiscal contractions have been associated with higher growth, even in the very short run. Similarly, economic activity slowed during several episodes of rapid fiscal expansions. These empirical observations have led to a significant interest in the so-called "non-Keynesian" effects of fiscal policy, and, in particular, in the response of private consumption to major fiscal changes.[1] However, descriptive evidence suggests that changes in private investment may explain a greater share of the response of GDP growth to large fiscal consolidations than changes in private consumption.[2] For this reason, we focus on the effects of fiscal policy on business investment. Since aggregate demand-driven models fail to capture significant aspects of fiscal policy in OECD countries, we concentrate on the supply side. In particular, we investigate how different components of the expenditure and revenue sides of the government budget influence profits and investment through their effects on the real wage in the private sector.[3]

The previous literature on the impact of fiscal policy on investment is rich and varied. There are many contributions on the effect of taxes on the cost of capital, using either aggregate or firm-level data. Although the cost of capital has been found to be significantly related to investment, the estimated elasticity tends to be small. Moreover, virtually all of these studies are country specific.[4] Several authors have also

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[1] For empirical work on "non-Keynesian" effects of fiscal adjustments on private consumption, see Francesco Giavazzi and Marco Pagano (1990), Perotti (1999), and Giavazzi et al. (2000). For theoretical work, see Olivier Jean Blanchard (1990), Giuseppe Bertola and Allan Drazen (1993), Alan Sutherland (1997), and Perotti (1999). For empirical evidence on fiscal expansions, see Alesina and Ardagna (1998).

[2] See Alesina et al. (1998).

[3] For a similar emphasis on profits see Michael Bruno and Jeffrey D. Sachs (1985) and Blanchard (1997). We share the focus on the composition of fiscal policy with Alesina et al. (1998) and Giavazzi et al. (2000).

[4] See Kevin A. Hassett and R. Glenn Hubbard (1996) for a review, Robert S. Chirinko et al. (1999) for evidence on

used numerical solutions of dynamic general-equilibrium models to study the macroeconomic effects of fiscal policy.[5] These models have emphasized the labor market as the channel of transmission for fiscal policy shocks. While we share with them the focus on the labor market, we do not use calibration methods. Instead, we estimate a q type of investment equation that links investment to present and expected future profits on panel data for eighteen OECD countries over the period 1960–1996.

We reach several conclusions. First, increases in public spending increase labor costs and reduce profits. As a result, investment declines as well. The magnitude of these effects is substantial. An increase of 1 percentage point in the ratio of primary spending to GDP leads to a decrease in investment as a share of GDP of 0.15 percentage points on impact and a cumulative fall of 0.74 percentage points after five years. The effect is particularly strong when the spending increases occur in the government wage bill: in this case, the decrease in the investment to GDP ratio is 0.48 on impact and 2.56 cumulatively after five years. Second, increases in taxes reduce profits and investment, but the magnitude of the effects on the revenue side is smaller than those on the expenditure side. Labor taxes have the largest negative impact on profits and investment. Third, the size of our coefficients suggests that there may be nothing special in the behavior of investment during periods of large fiscal adjustments. The fiscal stabilizations that have led to an increase in growth consist mainly of spending cuts, particularly in government wages and transfers, while those associated with a downturn in the economy are characterized by tax increases. Our econometric results imply that the different composition of the stabilization package can account for the observed difference in investment growth rates.

This paper is organized as follows. Section I develops a simple model to capture the effects of fiscal policy on investment and relates it to the relevant literature. Section II displays our main empirical results on the effects of fiscal variables on profits and investment. Section III extends the empirical analysis and discusses robustness. Section IV relates our results to the empirical evidence on large fiscal adjustments, and the last section concludes.

I. Profits, Investment, and Fiscal Policy

A. *Fiscal Policy in the q Theory*

We base our econometric investigation of the effects of fiscal policy on investment on a q model as in Andrew B. Abel and Blanchard (1986).[6] This theory provides a standard framework which highlights the central role of profits as a determinant of investment. This is important for us since we emphasize a channel linking fiscal policy to wages and profits.

The q theory is well known, hence we keep its discussion to a minimum. Let K_t denote the capital stock, I_t the rate of gross investment, L_t the labor input, r_t the one-period (expected) market rate of return, τ_t the tax rate on profits, and δ the rate of depreciation. Competitive firms maximize the expected present discounted value of cash flow, facing the net production function $F(K_t, L_t) - H(K_t, I_t)$. Both functions are homogeneous of degree one in their arguments. $H(\cdot)$ represents internal adjustment costs that are assumed to be quadratic, i.e.,

$$H(K_t, I_t) = \left[\frac{b}{2}\left(\frac{I_t}{K_t} - \varepsilon_t\right)^2 K_t\right]$$

where ε_t is a stochastic shock which is known when firms decide their inputs. Assume that capital becomes productive immediately, that the price of investment goods relative to the output price is one and that investment expenditures at time t are fully tax deductible. Under these assumptions, the investment rate is related to the shadow value of capital, λ_t, which equals the present discounted value of the marginal product of capital. In our benchmark case, we

the United States, Michael B. Devereux et al. (1994) on the United Kingdom, and Jason G. Cummins et al. (1996) for international evidence.

[5] See, in particular, Marianne Baxter and Robert G. King (1993), Sidney Ludvigson (1996), Lee E. Ohanian (1997), Mary G. Finn (1998), Valerie A. Ramey and Matthew D. Shapiro (1998), and Craig Burnside et al. (2000).

[6] The q theory of investment has not always been empirically successful. Our emphasis here, however, is not on a test of q theory versus alternatives. For a review of investment theory and empirics, see Ricardo J. Caballero (1999).

use the average gross-of-tax operating profits in the business sector as a share of the capital stock, π_{t+j}, to proxy for the gross-of-tax marginal product of capital.[7] Define the discount factor β_{t+j} as $\beta_{t+j} = (1 - \delta)/(1 + r_{t+j})$, and the "corporate tax factor" γ_{t+j} as $\gamma_{t+j} = (1 - \tau_{t+j})/(1 - \tau_{t+j-1})$. The first-order condition for investment can be written as:

$$(1)\qquad \frac{I_t}{K_t} = \frac{1}{b}\lambda_t + \varepsilon_t$$

$$= \frac{1}{b} E_t\left[\pi_t + \sum_{j=1}^{\infty}\left(\prod_{\nu=1}^{j} \beta_{t+\nu}\gamma_{t+\nu}\right)\pi_{t+j}\right] + \varepsilon_t.$$

If β_{t+j} and γ_{t+j} are constant over time, with the latter set equal to one (implying no changes in corporate taxes), we obtain:

$$(2)\qquad \frac{I_t}{K_t} = \frac{1}{b} E_t\left[\sum_{j=0}^{\infty} \beta^j \pi_{t+j}\right] + \varepsilon_t.$$

Summarizing, the investment rate is a function of the shadow value of capital, defined as the expected present discounted value of the marginal profitability of capital. Under standard assumptions, the latter is a decreasing function of the capital–labor ratio, which, from the first-order conditions for labor, is an increasing function of real labor compensation. Ceteris paribus, an increase, current or expected, in real compensation decreases profits and the shadow value of capital and, hence, investment. In turn, increases in government spending and taxation can depress profits and investment if they put upward pressure on private sector wages. This is the "labor-market channel" for the effects of fiscal policy that we focus on.

B. *Fiscal Policy, Wages, and Investment*

In this section, we briefly review how the main components of the spending and revenue side of the government budget influence profits and investment through their effect on the real wage in the private sector. This channel operates in models with both competitive and unionized labor markets, the latter being the norm in most countries in our sample.

Consider first government employment, and assume initially the labor market is perfectly competitive and taxes are lump sum, as in Finn (1998). An increase in government employment generates a negative wealth effect. If both leisure and consumption are normal goods, labor supply increases, but not enough to completely offset the higher government employment demand. Hence, employment and the marginal product of capital in the private sector fall. This is associated with an increase in the real wage, and a fall in investment, both during the transition and in steady state.

In the context of unionized labor markets, Ardagna (2001) shows that an increase in government employment or in government wages raises the real wage and depresses investment in the private sector as in Finn (1998), but for different reasons.[8] An increase in government employment raises the probability of finding a job if not employed in the private sector, and an increase in government wages increases the worker's income if employed in the public sector. In both cases, the reservation utility of the union members goes up and the wage demanded by the union for private sector workers increases, reducing profits and investment.

While the effects of changes in the government wage bill are, therefore, unambiguous both in competitive and unionized labor-market models, the effects of purchases of goods by the government are less clear-cut. In a real-business-cycle (RBC) model, when government purchases

[7] Using average profits per unit of capital is a legitimate approximation under the assumptions of perfect competition and linear homogeneity we used so far. Alternatively, if the production function is Cobb-Douglas, and the firm is imperfectly competitive, the marginal profitability of capital can be shown to be approximately equal to a multiple of the sales to capital ratio (S_t/K_t), i.e., it equals $\theta(S_t/K_t)$, where θ is the elasticity of output with respect to capital multiplied by the inverse of 1 plus the markup of prices over marginal costs.

[8] In Ardagna (2001) a monopoly union sets wages only for private sector workers, while the public wage is set exogenously by the government. Lars Calmfors and Henrik Horn (1986) study the determination of wages and employment in a model with a centralized union that bargains both for private and public sector workers; Bertil Holmlund (1997) does the same in a model with separate unions. These papers, however, do not have capital.

of goods increase, the wealth of the representative individual falls, causing (other things equal) his labor supply to increase, the real wage to fall, and output to increase. If taxes are lump sum, this wealth effect is the only one at work. If the increase in government spending is sufficiently permanent, the wealth effect is large, and so is the increase in output. Hence, investment also increases. If the increase in government spending is temporary, the wealth effect is small, output increases by little, and investment may fall (see Baxter and King, 1993).[9]

If government spending is, instead, financed by distortionary taxes on labor income, there are two additional effects: first, higher distortionary taxes raise the cost of work relative to leisure, inducing a ceteris paribus fall in labor supply (the intratemporal substitution effect); second, agents want to concentrate their work efforts when the tax rate is low (the intertemporal substitution effect). Depending on the time path of taxes and the elasticity of the individual labor supply, one can generate a variety of responses to spending shocks. If taxes increase sufficiently when spending increases, the individual will reduce his labor supply at the time of the spending shock, leading to a higher real wage.[10]

In the presence of tax distortions, it is also relatively easy to generate a *negative* effect of purchases of goods on private investment, even in the presence of quite persistent spending shocks.[11]

The last type of government spending we consider is transfers to individuals. An increase in lump-sum transfers to individuals obviously has no effects in a RBC model when taxation is lump sum. In a model with a union, however, an increase in subsidies to the unemployed raises the reservation utility of workers; the wage demanded by the union increases, and profits and investment fall.

Finally, consider labor taxation. To isolate its effects, suppose the contemporaneous and future government spending are held constant; therefore, an increase in taxes today implies a decrease in future taxes in order to satisfy the intertemporal government budget constraint. In a competitive labor-market model, both the intra- and intertemporal substitution effects described above predict a decrease in the labor supply and an increase in the real wage. The magnitude of the effect depends upon the elasticity of the individual labor supply. By contrast, in a union model, the effects of distortionary taxes on labor income do not depend on the elasticity of the individual labor supply. In fact, for most specifications of the union objective function and of the nature of the wage bargain, an increase in income taxes or social security contributions that reduces the net wage of the worker leads to an increase in the pretax real wage faced by the employer.[12] That is, the burden of labor taxes is borne in part by the firm, thus leading to a squeeze in profits.

C. *From Theory to Testing*

In order to estimate the effects of fiscal policy on investment, we must specify an estimable

[9] An increase in the real wage following an increase in public spending financed by lump-sum taxes can be generated in models with imperfect competition in output markets and increasing returns [see Julio J. Rotemberg and Michael Woodford (1992) and Devereux et al. (1996)]. In a two-sector neoclassical model with costs of shifting capital across sectors, Ramey and Shapiro (1998) show that an increase in spending concentrated in the goods produced by one sector (defense spending, in their case), can generate an increase in the real product wage of the other sector and even in the economywide consumption wage. However, in response to higher defense spending, fixed investment tends to increase. Ramey and Shapiro (1998) present empirical evidence that this is consistent with the behavior of fixed investment after major military buildups in the United States.

[10] See Burnside et al. (2000) for an assessment of the empirical adequacy of RBC models with distortionary taxation in explaining the response of real wages and hours following an exogenous shock to spending.

[11] The effects of public spending on goods have not been worked out in the context of general-equilibrium models with unionized labor markets. An exception is Ardagna (2001), where an increase in government purchases of goods does not have any effect on the real wage and investment because the monopoly union is myopic and public spending on goods does not enter the individual utility function.

[12] It is straightforward to derive the results described here in the case in which the union is a period-by-period maximizer, both in the case of a monopoly union [see Alesina and Perotti (1997); Francesco Daveri and Guido Tabellini (2000)], and in the case of a Nash bargaining between union and firms [see Richard Layard et al. (1991)]. If the union is an infinite-horizon maximizer, the problem becomes more complex, but the basic results tend to go through [see F. van der Ploeg (1987) and Devereux and Ben Lockwood (1991) on the determination of the capital stock in union models].

system linking government spending, taxes, and profits. We use a simple system of equations to construct a series for the shadow value of capital, λ_t, which we then use in the investment equation. We begin by capturing the effects of fiscal policy by a simple reduced-form profit equation:[13]

$$\pi_t = a_1\pi_{t-1} + a_2\pi_{t-2} + a_3G_t + a_4R_t + u_t \tag{3}$$

where G_t and R_t are public spending and revenues (or their components) as a share of trend GDP. Based on the discussion in Section I, subsection B, we expect a_3 and a_4 to be negative, particularly if we focus on changes to the government wage bill, transfers, and labor taxes. To predict government spending and revenues, we use a simple bivariate VAR:

$$R_t = d_{11}R_{t-1} + d_{12}R_{t-2} + d_{13}G_{t-1} + d_{14}G_{t-2} + \eta_t \tag{4}$$

$$G_t = d_{21}R_{t-1} + d_{22}R_{t-2} + d_{23}G_{t-1} + d_{24}G_{t-2} + \omega_t. \tag{5}$$

As described in the Appendix, G_t and R_t are cyclically adjusted. This alone may not fully eliminate endogeneity with respect to fluctuations of GDP. In fact, there could be a discretionary response of fiscal policy to business-cycle fluctuations. However, the budget for year t is discussed and approved during the second half of year $t - 1$. Additional small fiscal policy measures are sometimes decided during the year, but, most of the time, they become effective only by the end of the year. Thus, our assumption that cyclically adjusted G_t and R_t do not depend on current profits (or GDP) is likely to be a reasonable approximation.

Since, as pointed out above, the budget for year t is approved in period $(t - 1)$, we assume that G_t and R_t are known at the beginning of period t. By contrast, in our benchmark case, we assume that π_t is not in the information set at time t, which is a standard assumption in the empirical literature on the investment q.[14] Thus, the first term in the infinite sum that enters the construction of λ_t in equation (1) is the expected value of π_t conditional on the values of the variables on the right-hand side of (3). We routinely and successfully check that our estimates of the investment equation are not unduly sensitive to this assumption, that is, we also allow for the case of π_t belonging to the information set available at time t.[15]

D. *The Data*

All our data are from the OECD 1997 Economic Outlook Database (1997). Our sample includes 18 countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Netherlands, Norway, Spain, Sweden, United Kingdom, and United States, and covers a maximum time span from 1960 to 1996. Two small OECD countries, Luxembourg and Iceland, are excluded together with newly admitted members. New Zealand, Portugal, and Switzerland are not in the sample because of data problems. The Appendix contains the precise definition of all the variables we use.

Unit root tests run country by country on all the variables used did not allow us to reject the presence of a unit root for all the countries. However, given the low power of the Phillips-Perron test in small sample, we also implemented the unit root test proposed by Kyung So Im et al. (1995) on the panel. This time, the evidence was in favor of stationarity. Thus, we estimate our model in levels, always allowing for country fixed effects and for country-specific linear and quadratic trends.[16] In the sensitivity

[13] Tax policy that takes the form of incentives to capital spending, such as investment tax credits, also affects investment through the effective price of capital. We postpone the discussion of this issue to Section III, subsection B.

[14] See, among others, Abel and Blanchard (1986) and Simon Gilchrist and Charles Himmelberg (1998).

[15] In Section III, subsection A, we present a more general version of the system used to construct λ. In particular, we show that our results are largely unchanged if we add an output variable to the profit function and use a trivariate VAR that includes public spending, revenues, and GDP. Moreover, in Section III, subsection B, we allow for a variable discount factor.

[16] Ordinary least-squares (OLS) estimation in levels with country fixed effects (in addition to country-specific linear

section, we describe the results obtained when the model is estimated in first differences.

II. Empirical Results

In this section we present our benchmark results. We begin by showing our estimates of the profit and investment equations. We then use these equations together with the VAR for spending and taxes to estimate the effects of fiscal policy on investment. Finally, we present more evidence on the labor-market channel by looking at the behavior of private sector wages in response to changes in fiscal policy.

We discuss results both for total expenditures and revenues and for different subcomponents of spending and taxes since, as discussed in Section I, subsection B, not all components may have the same effects on the real wage. We consider a breakdown of spending into the government wage bill (*GW*),[17] purchases of goods by the government (*GOODS*),[18] and transfers (*TRAN*). Together, these components make up about 94 percent of primary expenditure in the typical budget of an OECD country; the only significant component that is left out is subsidies to firms. On the revenue side, in addition to total taxes, we consider separately taxes on labor income (*LABTAX*), indirect taxes (*TIND*), and business taxes (*BUSTAX*). In our sample, they represent 54 percent, 36 percent, and 8 percent of total revenues, respectively. We have chosen these aggregations because of our emphasis on the labor-market channel. Government wages are a crucial variable in this respect, and, to a lesser extent, so are transfers. Since we do not focus on the differences between government investment and consumption of goods and services, we lump them together. As for the revenue side, taxes on labor should affect labor supply. We also isolate business taxes to check their possible direct effects on profits and capital formation.

A. *Profits and Fiscal Policy*

We begin in Table 1 by presenting estimates of the profit equation in our benchmark case, with the marginal product of capital proxied by gross profits per unit of capital in the business sector.[19] In column 1, the fiscal variables are aggregate primary expenditure and revenues; columns 2–7 display the effects of the three main spending components (*GW*, *GOODS*, and *TRAN*) controlling for total revenues, and of the three main revenue components (*LABTAX*, *TIND*, and *BUSTAX*) controlling for total primary expenditure.

All the spending variables have a negative effect on profits. The estimated coefficients are all highly significant and their magnitude is substantial. Interestingly and consistent with the discussion in Section I, subsection B, government wages have the largest negative effect.

More specifically, an increase in primary government spending by 1 percentage point of trend GDP decreases profits as a share of the capital stock by about 0.1 percentage point on impact and by 0.3 percentage point in the steady state. Using an average of the capital stock in the business sector as a share of total GDP of about 1.9, the implied effects on profits as a share of GDP is about double, 0.17 on impact and 0.58 in steady state. An increase in *GW* by 1 percentage point of trend GDP is associated with a fall in profits as a share of GDP by 0.83 percentage points on impact and by 2.75 percentage points in steady state. An increase in total revenue relative to trend GDP of 1 percentage point has roughly the same effect as an increase in aggregate government spending and this effect is largely due to labor taxes. All these results are consistent with the labor-market channel of fiscal policy discussed above.

To get an idea of the magnitudes involved, consider the well-known Irish fiscal adjustment

and quadratic trends) yields consistent estimates since we have a panel with large T.

[17] The government wage bill is the product of the average government wage times total government employment. The sum of the government wage bill and of government purchases of goods on the current account is government consumption.

[18] This category includes purchases of goods on the current account (a component of government consumption) and on the capital account (or government investment). See the working paper version of this paper (Alesina et al., 1999) for results based on a breakdown between government purchases of consumption goods and investment goods.

[19] Results are very similar if the marginal product of capital is proxied by average profits in the business sector net of corporate tax payments or by the sales to capital ratio. See Tables 1 and 4 of the working paper version (Alesina et al., 1999).

TABLE 1—PROFITS AND FISCAL POLICY

Variable	1	2	3	4	5	6	7
$\pi(-1)$	0.67	0.66	0.70	0.69	0.66	0.68	0.68
	(17.45)	(17.27)	(18.17)	(17.41)	(17.03)	(17.45)	(17.54)
$\pi(-2)$	0.03	0.04	0.02	0.01	0.03	0.02	0.02
	(0.94)	(1.48)	(0.60)	(0.50)	(1.16)	(0.83)	(0.82)
R	−0.09	−0.10	−0.11	−0.10			
	(−3.05)	(−3.27)	(−3.65)	(−3.19)			
G	−0.09				−0.07	−0.10	−0.10
	(−4.31)				(−3.04)	(−4.56)	(−4.70)
GW		−0.43					
		(−6.33)					
$GOODS$			−0.19				
			(−3.22)				
$TRAN$				−0.11			
				(−2.45)			
$LABTAX$					−0.16		
					(−4.25)		
$BUSTAX$						0.02	
						(0.31)	
$TIND$							−0.08
							(0.13)
R^2	0.56	0.58	0.56	0.55	0.57	0.55	0.55
N	555	555	555	555	555	555	555

Notes: The dependent variable, π, is defined as business operating profits gross of taxes, divided by the capital stock. Revenues (R), labor taxes ($LABTAX$), taxes on business ($BUSTAX$), indirect taxes ($TIND$), primary spending (G), transfers ($TRAN$), government wage consumption (GW), government nonwage consumption + government investment ($GOODS$) are in share of trend GDP. R, $LABTAX$, $BUSTAX$, $TIND$, G, and $TRAN$ are cyclically adjusted. Country fixed effects and country-specific linear and quadratic trends are included. Values in parentheses are t statistics; N is the number of observations.

of 1986–1989. During that period, primary spending as share of GDP decreased from 37.9 percent in 1986 to 29.7 percent in 1989, and, in the same years, taxes were cut by almost 2.5 percentage points from 37.6 to 35.25. Using the coefficients of column 1 in Table 1, this change in fiscal policy would account for a ceteris paribus increase in profits as a share of GDP of 1.85 percentage points on impact and of about 6 percentage points in the steady state. These values match quite well the actual data for Ireland. In fact, between 1986 and 1989, profits as a share of GDP increased by 5.3 percentage points, from 16.6 percent to 21.9 percent.

B. *The Investment Equation*

Table 2 displays estimates of the investment equation (2).[20] Following Abel and Blanchard (1986) and Blanchard et al. (1993) we allow for some dynamics in our equation by letting not only the current but also the lagged value of the shadow value of capital [denoted by λ and $\lambda(-1)$ in the tables] to affect investment, and for an AR(1) error term. Since λ and $\lambda(-1)$ are generated regressors, we have corrected their standard errors.[21] In column 1, we compute λ assuming that current profits are not known at the beginning of the period, and we can therefore assume that the shadow value of capital is uncorrelated with the innovation in the AR(1)

[20] In this case, we assume the corporate tax factor $\gamma = 1$, and the discount factor $\beta = 1 - \delta - r = 0.88$, where $\delta = 0.1$ and $r = 0.02$, the average value in our sample.

[21] As shown by Adrian Pagan (1984), in the case of generated regressors, the estimates of their coefficients are consistent but their standard errors are not. We correct them by following the general procedure outlined in Kevin M. Murphy and Robert H. Topel (1985). The correction we use assumes that the error term of the second-stage regression is uncorrelated with the errors of the system of forecasting equations.

TABLE 2—INVESTMENT EQUATION

Variable	1	2	3
λ	0.10	0.07	0.05
	(8.10)	(8.87)	(2.44)
$\lambda(-1)$	0.006	0.06	0.06
	(0.53)	(7.17)	(6.89)
$AR(1)$ coefficient	0.65	0.70	0.68
	(19.36)	(21.34)	(18.17)
R^2	0.53	0.58	0.59
N	519	519	519

Notes: The dependent variable is the investment rate, I/K, defined as investment of the business sector divided by the capital stock. Marginal profit is proxied by business operating profits gross of taxes, π, divided by the capital stock. In column 1, we compute λ assuming that current profits are known with one-period delay. In columns 2 and 3, we assume that current profits are known at the beginning of the period. We always assume that the error term follows an $AR(1)$ process. In column 3, we use IV to account for the potential endogeneity of λ. Instruments used in column 3 are: $(I/K)(-1)$, $\lambda(-1)$, $\lambda(-2)$, R, G. See notes to Table 1 for the definition of the tax and spending variables. Country fixed effects and country-specific linear and quadratic trends are included. Values in parentheses are t statistics; N is the number of observations. Standard errors of the estimates have been corrected applying Murphy and Topel (1985).

process. In columns 2 and 3, we assume that profits are known at the beginning of the period, rather than with one period delay.[22] While in column 2 we do not correct for the potential endogeneity of λ, in column 3 we do so by using instrumental variables. As instruments we use $I/K(-1)$, $\lambda(-1)$, $\lambda(-2)$, R, G (which, remember, are assumed to be determined before time t).[23] Contemporaneous λ is a significant explanatory variable for investment in all columns of Table 2, and the one-period lagged value is statistically significant in columns 2 and 3. The point estimates of the coefficient of contemporaneous λ vary between 0.05 and 0.1, but the sum of the coefficients on λ and $\lambda(-1)$ is very similar in all cases and it varies between 0.11 and 0.13.

Interestingly, if we add G and R to the specification in columns 1–3, the coefficients on the fiscal variables are not significant, indicating that the effect of fiscal policy on investment is well captured by our dynamic model linking government spending and taxes to profits, and the latter to investment.[24]

C. *Dynamic Effects of Fiscal Policy on Investment*

We are now ready to trace out the effects of spending and revenue shocks on investment. We discuss two types of experiments. The first consists of estimating the effects of a permanent cut in primary government spending by 1 percent of trend GDP, and it is meant to give a rough idea of the order of magnitude of the effects of fiscal policy shocks. We abstract from the equations for taxes and spending (4) and (5) and we treat the latter as if they were set by the government independently of their own past. Starting from the profit equation in column 1 of Table 1, a permanent fall in G by 1 percent of trend GDP causes a permanent fall in profits as share of capital by $0.09/(1 - 0.67 - 0.03) = 0.3$ percentage points; using a value of β of 0.88, this leads to a change in λ by $0.3/(1 - 0.88) = 2.5$ percent. Using the estimate of column 1 in Table 2, investment increases by 0.27 percentage points as a share of the capital stock, and by 0.56 percentage points as a share of GDP.[25]

The second and more precise experiment consists of studying the impulse responses of investment to a shock to spending or revenues, using the estimates of the whole system [equations (2), (3), (4), and (5)]. In order to obtain a meaningful impulse response from the dynamic system (3), (4), and (5), we need innovations that are mutually orthogonal. While we have argued that the reduced-form innovations η_t and ω_t in (4) and (5) are orthogonal to u_t in equation (3), in general, they will be correlated with each other. This means that a shock to, say

[22] See the working paper version of this paper (Alesina et al., 1999) for details on the exact procedure followed to compute λ.

[23] Our results are very robust to including additional lagged instruments.

[24] Results on this point are available from the authors upon request.

[25] Note that here and in what follows we use the fact that

$$\frac{dI}{dx} = \frac{d(I/K)}{dx} \frac{K}{1 - (I/K)}$$

since K is the end of the period capital stock. Dividing by GDP we obtain the change of investment as a percentage of GDP. We set I/K to 0.07 and K/Y to 1.92, the average sample values.

TABLE 3—DYNAMIC EFFECTS OF FISCAL SHOCKS ON INVESTMENT/GDP

Variable	0 Year	1 Year	2 Years	5 Years	Sum 0 to 5	Sum 0 to 10
Panel A:						
G	−0.15**	−0.16**	−0.15**	−0.07*	−0.74**	−0.88**
R	−0.07*	−0.06*	−0.04	0.007	−0.17	−0.15
Panel B:						
GW	−0.48**	−0.60**	−0.54**	−0.21*	−2.56**	−2.86**
GOODS	−0.28**	−0.28**	−0.24*	−0.10*	−1.23**	−1.42*
TRAN	−0.21**	−0.22**	−0.21**	−0.10*	−1.05**	−1.25**
LABTAX	−0.17**	−0.17**	−0.13*	−0.03	−0.64*	−0.69*
BUSTAX	0.10*	0.11	0.10	0.07	0.56	0.71
TIND	0.08	0.08	0.08	0.05	0.44	0.56

Notes: See notes to Table 1 for the definition of the tax and spending variables.
* Zero is outside the 68-percent confidence band.
** Zero is outside the 95-percent confidence band.

ω_t, is not really a "spending shock," but a linear combination of the underlying structural spending and revenue shocks.[26] We orthogonalize the innovations in two ways: first, by letting revenues "come first," i.e., by adding R_t to the right-hand side of equation (5); alternatively, by letting spending "come first," i.e., by adding G_t to the right-hand side of equation (4). Both procedures give orthogonalized spending and revenue shocks by construction. If the correlation between the reduced-form innovations η_t and ω_t is small, then the impulse responses to the two orthogonalized spending shocks obtained with these two procedures will not differ much. In fact, in our sample the correlation between ω_t and η_t is indeed low, 0.13. We will present the case obtained when revenues come first. We also checked (and confirm) that our results are not unduly sensitive to the orthogonalization procedure.

Table 3 displays the changes in investment expressed as a share of GDP, following a shock by 1 percentage point of trend GDP at time t, to primary spending, revenues, and their main components, on impact and up to five years, and the cumulative change after the first five and ten years. A positive shock of 1 percentage point to the ratio of primary spending to GDP leads to a fall in the investment/GDP ratio of 0.15 percentage points on impact, and to a cumulative fall of 0.46 and 0.74 percentage points after two and five years respectively (see Panel A of Table 3). The effects are statistically significant.[27] Increases in taxes reduce investment but the magnitude of the tax effects is smaller and statistically significant only on impact and after one period. For instance, at the end of the fifth year the cumulative effect on the investment/GDP ratio is −0.17 percentage points, compared with −0.74 for spending.

The results on the components of spending are quite instructive. Consistent with our results on profits, the largest effect is from shocks to the government wage bill. For instance, if in the profit equation (3) and in the VAR for taxes and spending [(4) and (5)] we use *GW* instead of *G*, the impact effect of a positive shock to *GW* by 1 percent of trend GDP is a fall in the investment/GDP ratio by 0.48 percentage points; the cumulative effect at the end of the fifth year is a fall of 2.56 percentage points (see Panel B of Table 3). The effects are statistically significant at the 5-percent level. Labor taxes also have a sizable effect on private investment. In the system including *LABTAX* and *G*, an increase of labor taxes by 1 percent of GDP leads to a fall in the investment/GDP ratio by 0.17 percentage points on impact and by 0.69 percentage points in the steady state; the effect is significant at the 5-percent level on impact and after one year, and at the 10-percent level after five and ten years.[28]

[26] See Blanchard and Perotti (1999) for more discussion.

[27] Standard errors are computed by bootstrapping, based on 500 replications, following David E. Runkle (1987).

[28] If we assume that current profits are known at time t, the dynamic effects of fiscal policy are very similar to the ones obtained so far. The only difference lies in the impact

TABLE 4—PROFITS AND LABOR COSTS

Variable	1 2SLS	2 2SLS	3 2SLS	4 2SLS	5 2SLS	6 2SLS	7 2SLS
$\pi(-1)$	0.63	0.59	0.66	0.68	0.55	0.63	0.62
	(14.02)	(13.52)	(11.47)	(14.67)	(11.64)	(14.55)	(14.23)
$\pi(-2)$	0.03	0.05	0.02	0.02	0.07	0.04	0.04
	(1.19)	(1.71)	(0.76)	(0.55)	(2.12)	(1.30)	(1.34)
WP	−0.10	−0.15	−0.07	−0.05	−0.19	−0.11	−0.11
	(−3.32)	(−5.35)	(−1.38)	(−1.44)	(−5.87)	(−4.14)	(−4.08)
R^2	0.60	0.59	0.59	0.58	0.56	0.60	0.60
N	555	555	555	555	555	555	555

Notes: The dependent variable, π, is defined as business operating profits gross of taxes, divided by the capital stock. *WP* is defined as log of real labor compensation per employee of the business sector. Instruments used in columns 1–7 are $\pi(-1)$, $\pi(-2)$, and the fiscal policy variables in the corresponding columns of Table 1. Country fixed effects and country-specific linear and quadratic trends are included. Values in parentheses are t statistics; N is the number of observations.

D. *Fiscal Policy and the Real Wage*

We have argued that the effects we have documented of fiscal policy on profits and investment are intermediated largely by the labor market. More evidence on this channel can be obtained by regressing profits on real private labor cost per employee instrumented by the fiscal policy variables that appear in the profit equation.

Table 4 presents estimates of a profit equation which includes amongst the explanatory variables the log of real labor compensation per employee of the business sector (denoted by *WP*), instrumented by the appropriate fiscal policy variables. In each column, the fiscal policy instruments are the fiscal policy variables appearing in the corresponding column of Table 1. Hence, these equations can be interpreted as the "structural" profit equations behind the "reduced-form" equations estimated in Table 1. The results are supportive of our hypothesis and are very robust: the coefficient of private labor compensation is always negative and almost always significant. Moreover, the coefficient is higher when *GW* and *LABTAX* are used as instruments (see columns 2 and 5).[29]

Table 5 displays the first-stage regressions of each equation estimated in Table 4. That is, in each column we regress the log of real labor compensation on profits lagged once and twice and on the fiscal policy variables used as instruments in the corresponding column of Table 4. In accordance with the labor-market channel story discussed in Section I, subsection B, the coefficients on all government spending variables are always positive and significant, and the coefficient on *GW* is the largest. The coefficient on *LABTAX* is also always positive and significant, while the one on total revenue (R) is negative and significant. Columns 6 and 7 show that the negative coefficient on R is due to the behavior of business and indirect taxes.

As an additional test, we reestimate columns 1–7 of Tables 4 and 5 including wages lagged once and twice in the instruments' set. The coefficients on lagged wages are statistically significant. The coefficients on spending items and *LABTAX* remain positive and significant at the 5-percent level. Moreover, the coefficient on R becomes now insignificant. Hence, our basic conclusions concerning the effects of spending and labor taxes on labor costs still hold.[30]

effect which is now smaller, because the coefficient of contemporaneous q is smaller (see columns 2 and 3 of Table 2). However, the cumulative effects after five or ten years are virtually identical.

[29] The same results also hold when we use several alternative sets of instruments, including lagged GDP.

[30] In Table 5, the coefficient of profits lagged once is negative and significant, while it is not significant if we include lagged wages as additional regressors. This suggests that in the wage equation lagged profits may act as an inverse proxy for lagged wages. Strictly speaking, if lagged wages are included in the instrument set, they should also be included in the reduced-form equation for profits. When we do this, the coefficients of R and G and their components are very similar to the one in Table 1. Excluding lagged wages from the profit equation (3) simplifies the system of fore-

TABLE 5—LABOR COSTS AND FISCAL POLICY

Variable	1	2	3	4	5	6	7
$\pi(-1)$	−0.67	−0.63	−0.85	−0.64	−0.59	−0.57	−0.65
	(−5.69)	(−5.41)	(−6.85)	(−5.37)	(−4.91)	(−4.97)	(−5.59)
$\pi(-2)$	0.21	0.16	0.30	0.26	0.17	0.18	0.19
	(2.31)	(1.75)	(3.12)	(2.94)	(1.90)	(2.03)	(2.14)
R	−0.37	−0.32	−0.24	−0.39			
	(−4.01)	(−3.60)	(−2.54)	(−4.23)			
G	0.65				0.54	0.51	0.55
	(9.85)				(7.67)	(7.91)	(8.55)
GW		2.33					
		(11.42)					
$GOODS$			1.04				
			(5.29)				
$TRAN$				1.39			
				(9.68)			
$LABTAX$					0.38		
					(3.13)		
$BUSTAX$						−1.49	
						(−7.47)	
$TIND$							−1.14
							(−6.28)
R^2	0.22	0.26	0.13	0.22	0.21	0.27	0.25
N	555	555	555	555	555	555	555

Notes: The dependent variable, WP, is defined as the log of real labor compensation per employee of the business sector. The variable π is defined as business operating profits gross of taxes, divided by the capital stock. See notes to Table 1 for the definition of the tax and spending variables. Country fixed effects and country-specific linear and quadratic trends are included. Values in parentheses are t statistics; N is the number of observations.

III. Extensions and Robustness

Our results are robust to a variety of specification changes. In what follows, we discuss two main extensions to our benchmark regressions. First, we introduce GDP in the system of equations used to construct the shadow value of capital. Second, we allow for a variable discount factor. Finally, we summarize the results of additional robustness checks.

A. *Adding GDP*

In Table 6, we augment our basic profit regression with a measure of "private GDP," namely the ratio of total GDP less government consumption divided by the capital stock, denoted by $GDPP$. This measure of the volume of sales per unit of capital is positively associated with the profit rate, when either its lagged value

TABLE 6—ADDING GDP

Variable	1 OLS	2 2SLS
$\pi(-1)$	0.53	0.55
	(12.8)	(15.7)
$\pi(-2)$	−0.07	−0.09
	(−2.25)	(−3.21)
R	−0.09	−0.08
	(−3.28)	(−3.2)
G	−0.11	−0.09
	(−5.49)	(−5.16)
$GDPP(-1)$	0.15	
	(7.49)	
$GDPP$		0.20
		(9.15)
R^2	0.60	0.69
N	555	555

Notes: The dependent variable, π, is defined as business operating profits gross of taxes, divided by the capital stock. $GDPP$ is defined as total GDP minus government consumption, divided by the capital stock. See notes to Table 1 for the definition of the tax and spending variables. Instruments used in column 2 are $\pi(-1)$, $\pi(-2)$, R, $R(-1)$, G, $G(-1)$, $GDPP(-1)$, and $GDPP(-2)$. Country fixed effects and country-specific linear and quadratic trends are included. Values in parentheses are t statistics; N is the number of observations.

casting equations needed to construct λ. Results on the specifications that include lagged wages are available upon request.

or its contemporaneous value is introduced in the equation. In the latter case, we estimate the equation with instrumental variables. The choice of instruments is standard: lagged variables of profits and *GDPP* and contemporaneous and lagged fiscal policy variables.

While the coefficient of *GDPP* is positive and significant, our conclusions on the effect of fiscal policy on profits still hold: the coefficients on G and T and their components remain significant and are practically identical to the ones reported in Table 1. If we use the new profit equation, in conjunction with a trivariate VAR including T, G, and *GDPP* to construct λ, our results on investment are also virtually unchanged.

The dynamic response of investment to fiscal policy changes is also similar to the one in Table 3. Consider, for example, augmenting the profit equation (3) and the VAR described by equations (4) and (5) with an equation for *GDPP* and adding the lagged value of the latter to the right-hand side of the profit equation, as in column 1 of Table 6. A reduction by 1 percentage point in spending as a share of GDP reduces the investment/GDP ratio by 0.16 percentage points on impact, and by 0.60 after five years. In the benchmark model in Table 3 these values are 0.15 and 0.74, respectively.

B. *Variable Discount and Corporate Tax Factors*

We now allow the firm's discount factor β_t and the corporate tax rate factor γ_t to vary over time in a linearized version of equation (1). Omitting additive constants and using the approximations $\beta_{t+j} \simeq 1 - r_{t+j} - \delta$ and $\gamma_{t+j} \simeq 1 - ((\tau_{t+j} - \tau_{t+j-1})/(1 - \bar{\tau}))$, we obtain:

$$(6) \quad \frac{I_t}{K_t} \simeq \frac{1}{b} E_t \Bigg[\sum_{j=0}^{\infty} (\overline{\beta\gamma})^j \pi_{t+j} - \vartheta_0 \sum_{j=0}^{\infty} (\overline{\beta\gamma})^j r_{t+j+1} + \vartheta_1 \Bigg(\tau_t - (1 - \overline{\beta\gamma}) \sum_{j=0}^{\infty} (\overline{\beta\gamma})^j \tau_{t+j+1} \Bigg) \Bigg] + \varepsilon_t$$

where variables with a bar denote sample means, $\vartheta_0 = \overline{\pi\gamma}/(1 - \overline{\beta\gamma})$, and $\vartheta_1 = \overline{\pi\beta}/(1 - \overline{\beta\gamma})[1/(1 - \bar{\tau})]$. The variable r is the real rate of interest defined as the nominal rate at time t net of taxes minus the inflation rate between $t + 1$ and t, and τ is the corporate tax rate. Equation (6) makes clear that changes in the shadow value of capital λ_t can be due to (i) changes to average profits, (ii) changes to the net real rate of interest, and (iii) changes to the corporate tax rate (given the net of taxes interest rate). In order to estimate this model, we estimate a regression for the real interest rate analogous to the one for profit (3), and we add an equation for the corporate tax rate to the VAR in (4) and (5).

In the interest rate equation, the coefficient of R (i.e., tax revenues) is positive and significant, while the one on G (i.e., government spending) is negative and significant. These findings are somewhat counterintuitive, but are consistent with those obtained by others.[31] In the investment equation, the interest rate term has a negative and statistically significant coefficient, while changes in the corporate tax rate term do not have any statistically significant effect.[32]

Turning to the impulse responses, the reaction of investment to a shock in spending is slightly smaller than in the benchmark case. A positive shock to spending reduces investment through its effects on profits, but it also has a negative effect on the real interest rate, thus increasing investment. By contrast, a shock to revenues has a stronger effect on investment than in the benchmark case.

We further investigated the robustness of our results by using a different measure of the corporate tax rate, and by considering the effects of investment tax credits and depreciation allowances. Cummins et al. (1996) provide data on the statutory marginal corporate income tax rates and data on investment tax credits for subsamples of our countries, for the period

[31] For instance, Robert J. Barro and Xavier Sala-i-Martin (1990), in a panel study on OECD countries on the effects of fiscal policy on interest rates, find that government deficit is *negatively* associated with the interest rates in many specifications.

[32] Results are reported in our working paper (Alesina et al., 1999).

1981–1992.[33] We update their series to 1996 for their sample of countries using the reports of the International Bureau of Fiscal Documentation. We first estimate the investment equation by replacing our measure of the corporate tax rate with the marginal statutory tax rate. Second, we allow for investment tax credit and depreciation allowances.[34] For comparison, we also reestimated the equation with our original measure of the capital tax rate for the subsample of countries in Cummins et al. (1996). The bottom line is that our results on the effects of fiscal policy on profits, and of profits on investment, are robust to the use of these additional tax variables. The coefficients on the term capturing changes in the corporate tax rate are sometimes, but not always, significant, and with a negative sign. The coefficient of the variable measuring tax credits is positive and statistically significant, contrary to what the theory suggests.[35]

C. *Additional Robustness Tests*

We have conducted several other robustness checks. First, we have reestimated all our regressions with variables in first differences rather than in levels. In fact, as discussed above, unit root tests country by country and on the whole panel lead to opposite conclusions about the order of integration of the series. The basic results are unaffected; in fact, in many respects they are even stronger. In the case of a shock to taxes, the negative cumulative effect on investment after five years is almost five times as large in the model in differences compared to the one in levels. It is of the same order of magnitude as the effect of a shock in spending, which, instead, is largely unchanged across the two models.[36]

Second, we have added year dummies in the regressions as an additional way of controlling for common shocks to all countries in the sample. Our main results remain unaltered. Government wages and labor taxes are always significant and with the expected sign. The same is true for the aggregate measure of spending and revenues, G and T (with the exception of the case in which G is used in conjunction with $LABTAX$). Third, we have reestimated the profit and investment equations by dropping one country at a time: none of the resulting 18 regressions for each equation is significantly different from the regressions we present in the paper. Fourth, we have estimated the profit and investment equations country by country. Although the results have to be interpreted with caution, the basic picture is encouraging. In the level regressions, the effect of government spending on profits is negative and significant at the 5-percent level in 10 out of 18 countries; of the remaining eight countries, government spending has a negative, but insignificant coefficient in four countries. No country has a significant positive coefficient. The results on taxes in the profit equation are slightly less strong. In the investment equation, in ten countries, contemporaneous and/or lagged values of λ are statistically significant determinants of investment. In seven countries, however, neither contemporaneous nor lagged values of λ are significant, and in one country the coefficient on λ is positive and insignificant, but the coefficient on lagged λ is negative and significant at the 10-percent level. We also reestimated the profit and investment equations country by country in first differences, and the results are similar to those from the regressions in levels, in fact, slightly stronger.

Finally, we have also explored whether current profits matter more than expected ones

[33] The countries in their sample are: Australia, Belgium, Canada, Denmark, France, Germany, Ireland, Italy, Japan, the Netherlands, Norway, Sweden, the United Kingdom, and the United States.

[34] If we allow for investment tax credit and depreciation allowances, an additional term that captures the tax-adjusted price of investment goods must be included in the investment equation. The term has the form

$$\frac{1 - \eta_t - D_t}{1 - \tau_t} P_t^I$$

where η_t is the rate of investment tax credit, D_t the tax saving due to depreciation allowances on new investment, and P_t^I is the real price of investment goods. D_t is approximated using the formula on page 280 of Michael A. Salinger and Summers (1983).

[35] As one of the referees suggested, this could be because investment tax credits may be countercyclical.

[36] For these and other results summarized in this subsection, see the working paper version of this article (Alesina et al., 1999).

TABLE 7—FISCAL ADJUSTMENTS AND THE MACROECONOMY

	Expansionary				Contractionary			
Measure	Before	During	After	After − before	Before	During	After	After − before
Primary spending	42.96	41.71	41.36	−1.60	40.32	40.24	40.15	−0.17
	(1.43)	(1.42)	(1.35)	*	(1.36)	(1.37)	(1.40)	
Total revenue	40.10	41.42	41.57	1.47	36.97	39.03	39.65	2.69
	(1.45)	(1.43)	(1.41)	*	(1.48)	(1.51)	(1.58)	*
GDP growth rate	−0.79	−0.45	−0.19	0.60	0.82	−1.12	−0.86	−1.68
(deviation from G7)	(0.24)	(0.33)	(0.31)		(0.40)	(0.44)	(0.28)	*
GDP growth rate	1.31	2.65	3.41	2.10	3.73	1.34	1.91	−1.82
	(0.24)	(0.39)	(0.29)	*	(0.37)	(0.34)	(0.27)	*
Private consumption	1.16	2.30	3.03	1.87	3.76	1.19	1.84	−1.93
growth rate	(0.36)	(0.38)	(0.30)	*	(0.55)	(0.45)	(0.31)	*
Business investment	−0.36	3.49	5.24	5.60	4.59	−0.39	0.29	−4.30
growth rate	(0.99)	(1.24)	(1.13)	*	(1.22)	(1.60)	(1.31)	*
Contribution to real GDP growth from private consumption	51.37	51.09	51.82	0.45	58.41	48.92	57.78	−0.63
Business investment	−6.55	16.44	17.17	23.72	13.40	−7.22	−0.84	−14.23
Residential investment	−23.78	0.19	2.90	26.69	4.88	−7.07	1.15	−3.73
Stockbuilding	−16.08	1.58	7.60	23.68	2.12	2.16	−12.28	−14.39
Net export	69.36	29.60	4.08	−65.28	−2.33	30.60	37.04	39.37
Government consumption	28.28	6.37	12.71	−15.57	17.95	27.25	20.01	2.06
Government investment	−6.86	−6.94	2.23	9.09	3.54	−10.95	−4.86	−8.40

Notes: Primary spending and total revenue are in share of trend GDP and cyclically adjusted. GDP growth rate (deviation from G7) is the real GDP growth rate in deviation from the weighted average (calculated using GDP weights) of the G7 countries' real GDP growth rate. Private consumption growth rate and business investment growth rate are the growth rates of real private consumption and real business investment.

The contributions to real GDP growth from the different GDP components have been calculated using the following formula. Let sh = the contribution to real GDP growth from the X component:

$$sh = \frac{\sum_j [((X_{jt} - X_{jt-1})/X_{jt-1}) \times X_{jt-1}/GDP_{jt-1}]}{\sum_j [(GDP_{jt} - GDP_{jt-1})/GDP_{jt-1}]}.$$

An episode of fiscal adjustment is expansionary (contractionary) if the primary cyclically adjusted balance as a share of trend GDP improves by at least 2 percent in one year or by 1.25 percent in two consecutive years and the average real GDP growth in each adjustment year and in the two years after is greater (lower) than the average real GDP growth in the two years before.

Source: OECD.

because of financial constraints, and/or because firms pay much more attention to current profitability than to the expected future one. We find considerable evidence that current profits and expected profits in the near future (one to two years) matter more than the discounted ones in the more distant future. Our results on the effects of fiscal policy are, however, very robust to various experiments on the time horizon used to calculate λ.

IV. Large Fiscal Adjustments

The literature on large fiscal adjustments has highlighted an important empirical regularity. Fiscal adjustments which rely mostly on spending cuts, and particularly on transfers and government wages, are associated with a surge in growth during and immediately after the adjustment; we label these adjustments "expansionary," because of the positive growth which goes with them. The opposite occurs in the case of adjustments which are tax based; we label these episodes "contractionary" because they lead to a downturn.

While most of the literature has focused on consumption, Table 7 shows that business investment displays a large amount of variability around fiscal adjustments: business investment booms during expansionary fiscal adjustments

TABLE 8—BUSINESS INVESTMENT AROUND FISCAL ADJUSTMENTS

Measure	Expansionary Before (a)	Expansionary During (b)	Expansionary After (c)	Expansionary Difference (c − a)	Contractionary Before (a)	Contractionary During (b)	Contractionary After (c)	Contractionary Difference (c − a)
Data:								
GDP growth rate	1.31	2.65	3.41	2.10	3.73	1.34	1.91	−1.82
	(0.24)	(0.39)	(0.29)	*	(0.37)	(0.34)	(0.27)	*
Business investment growth rate	−0.36	3.49	5.24	5.60	4.59	−0.39	0.29	−4.30
	(0.99)	(1.24)	(1.13)	*	(1.22)	(1.60)	(1.31)	*
Business investment contribution to GDP growth	−6.55	16.44	17.17	23.72	13.40	−7.22	−0.84	−14.23
Benchmark Model:								
Business investment growth rate	0.89	2.53	4.27	3.38	2.88	4.67	0.13	−2.75
Business investment contribution to GDP growth	5.58	10.3	13.84	8.26	7.57	43.1	0.43	−7.14
Model with GDP and Variable Discount Factor:								
Business investment growth rate	0.10	0.06	4.06	3.96	3.45	3.94	−0.56	−4.01
Business investment contribution to GDP growth	−1.52	−2.18	12.57	14.09	10.22	37.20	−3.68	−13.9

Note: See notes to Table 7.

and collapses during the contractionary ones.[37] In fact, changes in business investment explains a large part of the change in GDP growth around these large fiscal stabilizations. In the two years before the expansionary adjustments, on average business investment contributes negatively to the (small) increase in GDP growth, while changes in consumption are responsible for approximately half of that increase.[38] After the adjustment, the average contribution from business investment to the (large) change in GDP growth jumps by almost 24 percentage points, while the contribution from changes in private consumption is constant. The exact opposite happens in the episodes of fiscal adjustments associated with downturns in the economy.

In Table 8 we use our estimated model to see how well it "matches" the behavior of investment around the episodes of fiscal adjustments described in the previous table. We use the fitted value for the investment rate (I/K) together with actual GDP and capital stock figures to calculate the "predicted" growth rate of business investment and the "predicted" investment to GDP ratio for each country. We then average across episodes to make our results comparable with those in Table 7.

We present results based on two models, the benchmark and one with both GDP in the profit function and a variable interest rate in the investment equation. Both of them, particularly the latter, do quite well at matching the actual data. For instance, with the richer model we predict a difference in the average rate of growth of investment before and after "expansionary" fiscal adjustment of 3.96 compared to 5.60 in the data, and of −4.01 against −4.30 in the case of "contractionary" fiscal adjustments. In some cases the model predicts the "jumps" of the investment share with one year delay relative to the actual data. A more thorough analysis of this timing issue would require quarterly data on fiscal variables which are not available for many OECD countries.

Finally, we investigated whether the behavior of profits and investment is structurally different

[37] See notes to Table 7 for the precise definition of expansionary and contractionary fiscal adjustments.

[38] The contribution to GDP growth from each component of aggregate demand weights its growth rate with the share of each component relative to GDP. This quantity is then expressed as a proportion of the GDP growth rate. See the notes to Table 7 for details.

following large changes in the fiscal policy stance. First, we checked whether a quadratic term on spending and taxes was significant in the profit equation; it was not. Second, we found no structural breaks in the profit equation or in the investment equation around the time of large fiscal adjustments. For completeness, we have also performed analogous experiments on episodes of loose fiscal policies. Our results (available upon request) are consistent with those obtained for fiscal adjustments.

V. Conclusions

This paper shows that in OECD countries changes in fiscal policy play an important role for private business investment. Interestingly, the strongest effects arise from changes in primary government spending, especially in the government wage bill. We provide evidence consistent with a labor-market channel through which fiscal policy influences labor costs, profits, and, as a consequence, investment. Increases in public wages and/or employment put upward pressure on private sector wages; this is consistent with competitive or unionized labor-market models. Also, workers in the private sector may react to tax hikes or more generous transfers by decreasing the labor supply or asking for higher pretax real wages, once again leading to declining profits and investment.

These effects on investment go a long way toward explaining those episodes of fiscal contractions associated with higher growth that have recently attracted considerable attention. According to our results, the surge in private investment that accompanies the large spending cuts during these episodes is exactly what one should expect. In fact, we find very little evidence that private investment reacts differently during these large fiscal adjustments than in "normal" circumstances. This result questions the need for "special theories" for large versus small changes in fiscal policy.

Appendix

Variables' Definitions

I/K: Business investment as a share of capital stock.

π: Profits gross of corporate tax payments as a share of capital stock. Profits are value added in business sector minus labor costs in the business sector.

Labor costs in the business sector: Labor compensation per employee in the business sector times total employment of the business sector. The number of unpaid family workers are deducted from total employment of the business sector because their output is not measured. We followed Blanchard (1997) in doing this adjustment. When the number of unpaid family workers is not available from the beginning of the sample, for each country, we assume that the ratio of unpaid family workers to total employment is equal to the one in the first year for which the data are available.

WP: Log of real labor compensation per employee in the business sector, calculated using the GDP deflator.

r: Short-term nominal interest rate net of corporate taxes minus one period ahead (*ex post*) inflation, calculated using the GDP deflator.

G: Primary spending (cyclically adjusted) as a share of trend GDP. Primary spending $= TRAN + GW + GOODS +$ subsidies $+$ other net capital outlays.

R: Total revenues (cyclically adjusted) as a share of trend GDP. Total revenues $= LABTAX + BUSTAX + TIND +$ other revenues received by the government.

$TRAN$: Transfers (cyclically adjusted) as a share of trend GDP.

GW: Wage component of current government spending on goods and services as a share of trend GDP.

$GOODS$: Nonwage component of current government spending on goods and services as a share of trend GDP + government investment as a share of trend GDP.

$LABTAX$: Labor taxes (direct taxes on households + social security and payroll taxes, cyclically adjusted) as a share of trend GDP.

$BUSTAX$: Direct taxes on business (cyclically adjusted) as a share of trend GDP.

$TIND$: Indirect taxes (cyclically adjusted) as a share of trend GDP.

Cyclical Adjustment

Each component of revenues—direct taxes on households, business taxes, indirect taxes, and social security contributions—is cyclically adjusted by computing the value of the component if GDP were at its trend level instead of at its actual level, using the GDP elasticities provided by the OECD. We calculate trend GDP separately for each country in the sample, by regressing log GDP in real terms on a constant, a linear, and a quadratic trend.[39] Hence, for each component of revenues we compute:

$$R_{it}^{CA} = R_{it}^{NCA}(GDPVTR_t/GDPV_t)^{a_i} \tag{A1}$$

where R_{it}^{CA} is the cyclically adjusted revenue item, R_{it}^{NCA} is the actual revenue item, $GDPVTR_t$ is trend real GDP, $GDPV_t$ is real GDP, and a_i is the elasticity of the revenue item i to real GDP. A similar adjustment is applied to total primary spending and transfers.[40] We then divide each cyclically adjusted revenue component and each spending component by trend GDP.

[39] Thus, we apply the same cyclical adjustment as the OECD, except that we use trend GDP as the reference value of output, rather than potential output as calculated by the OECD. See *Fiscal Position and Business Cycles, Users' Guide for Statistics* (OECD), for the values of the tax elasticities. We also used the Hodrick-Prescott filter to estimate trend GDP, obtaining similar results.

[40] The OECD does not provide the values of the transfers elasticities. We used the elasticities provided for total primary spending and scaled them up by the ratio of transfers to total primary spending. This is correct under the reasonable assumption that transfers are the only cyclically sensitive component of government spending.

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