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A LEVY INSTITUTE MODEL FOR GREECE

TECHNICAL PAPER

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Summary

In this report, we present the main characteristics of a stock-flow consistent model for Greece, estimated on quarterly data over the last 30 years and built to provide us with a "tool for thinking," in the words of Wynne Godley (the architect of such models), to explore the implications of alternative policy options for the Greek economy. This report focuses on the technical structure of the model, which will be used in subsequent Strategic Analysis reports for projecting the trajectories of the Greek economy for the next four to five years, conditional on assumptions about alternative economic policies.

1. LIMG: A Levy Institute Model for Greece

In the macroeconomic model for the Greek economy we have developed, henceforth LIMG, we adopt the "New Cambridge" approach, which is also the basis of the Levy Institute model for the US economy. That model has shown itself to be extremely effective for constructing reliable medium-term economic scenarios. In addition, the reconstruction of macroeconomic data for Greece, discussed in an interim report,[1] has shown many similarities—as well as differences—with the evolution of the US economy and of other developed economies in Europe. We refer in particular to the stability of private sector net saving relative to income up to the 1990s, when this flow-flow ratio started to drift toward negative territory, implying an unsustainable accumulation of private sector debt, which was followed—in Greece more prominently—by a large and rapidly increasing public sector debt relative to GDP.

The model considers the private sector as a whole, combining households and firms and considering their receipts and outlays with the other two sectors—the government and the rest of the world—focusing in particular on their financial balances, which imply in turn a path for the net wealth or debt of each sector.

The accounting for flows is summarized in Table 1, using the conventional approach of social accounting matrices pioneered by Richard Stone, where payments are recorded in the columns, receipts are recorded in the rows, and payments and receipts related to production are dealt with separately. Transactions that involve a capital account are also considered separately, and could be detailed in a flow-of-funds matrix.

1 Papadimitriou et al. (2012).

Table 1. Social accounting matrix for the LIMG model						
	1. Prod.	2. Priv. S.	3. Gov.	4. RoW	5. CA	6. Total
1. Production		+PX	+G	+NX		+GDP
2. Private sector	+VAp		+TRgp	+TRwp		+YP
3. Government	+NIT+Ggos	+DT		+TRwg		+YG
4. Rest of the world	+NITw	+TRpw	+TRgw			+YW
5. Capital account		+S	– GDEF	– CA		0
6. Total	+GDP	+YP	+YG	+YW	0	

In this first version of the model (as in the Levy Institute US model), we do not consider the stock of physical capital explicitly, and investment is therefore accounted as part of private expenditure (*PX*). This implies that private sector saving (*S*) is already net of investment spending. In our econometric analysis, we will nevertheless verify—in future research—our results on the determinants of private expenditure with an analysis of its main components: consumption and investment.

The matrix records end-of-period values, which are in accounting equilibrium, since—for production—any discrepancy between production and demand is recorded as a change in inventories treated as investment and incorporated into private expenditure, and value added is obtained as the residual between the value of sales and indirect taxes paid to the government.[2]

Saving for each sector is obtained as the residual between receipts—the row total—and all other payments; this therefore ensures that the total of rows two to five is equal to the total for the corresponding column. The sixth row and column, for "net payments to the capital account," is implied by the identities of the previous rows and columns. We use *GDEF* for the negative saving of the government and *CA* for the external current account.

The accounting of Table 1 therefore implies the set of the following identities:

1) $GDP = PX + G + NX$

2) $YP = VAp + TRgp + TRwp - TRpw = GDP - NIT - Ggos - NITw + TRgp + TRwp - TRpw$

3) $S = YP - PX - DT$

4) $YG = NIT + Ggos + DT + TRwg$

5) $GE = G + TRgp + TRgw$

2 Profits paid abroad are considered later, as transfers from the private sector to the rest of the world.

6) $GDEF = GE - YG$

7) $CA = NX + TRwp + TRwg - (TRpw + TRgw + ITw)$

I1) $S = GDEF + CA$

where the last identity is not included in the numbered sequence because it must be verified by the previous relations.

We use an oversimplified flow-of-funds matrix, detailed in Table 2.

Table 2. Flow of funds for the model

	Priv. S.	Gov.	RoW	Total
Government debt	+ΔDGp	–ΔDG	+ΔDGw	0
Net private sector liabilities	–ΔPSL		+ΔPSL	0
Total	+S = ΔFA	–GDEF	–CA = –ΔFW	0

We are assuming that the government does not hold financial assets, and treat symmetrically private sector liabilities that are assets of the rest of the world, and financial assets issued by the rest of the world and held by the private sector. The logic implies that any increase in net saving for the private sector can only (a) increase the amount of government bills held, and/or (b) increase (decrease) the amount of foreign (domestic) liabilities held domestically (by the RoW).

The corresponding stocks can be obtained through the standard stock-flow identity:

$$Stock(t+1) = Stock(t) + Flow(t) + NCG(t) - DS(t)$$

where *NCG* stands for net capital gains and *DS* stands for a reduction in the stock, which may arise, for instance, by default on a debt. Our experience with the Levy Institute US model shows it is useful to estimate stocks at historic cost; that is, without taking into account net capital gains. We therefore constructed the following stock variables, cumulating the flows starting from sensible values at period "zero":

8) $DG = DG(-1) + GDEF$

9) $FA = FA(-1) + S$

I2) $FW = FW(-1) + CA$

10) $FW = FA - DG$

where again the value of (the change in) net foreign wealth *FW* is implied by accumulation of net financial assets from the private sector and government deficit.

All stocks of wealth or debt will generate interest payments—or profits—in the following periods, and we are interested in modeling these payments consistently. We are also interested in obtaining more detail on some payments made by, say, the government sector and the private sector, in order to endogenize those components—such as unemployment benefits—which vary more or less automatically in concert with the business cycle.

11) $TRpw = Rf \cdot PSL(-1) + NPY + CEPA + TROpw$

12) $TRgp = Rg \cdot DGp(-1) + SBEN - SOC + TROgp$

13) $TRgw = Rg \cdot DGw(-1)$

where we have made explicit net interest payments from the private sector to the RoW; net property income (*NPY)* paid abroad; net compensation of employees paid abroad (*CEPA)* in total transfers from the private sector to the RoW; interest paid domestically on government debt; social benefits (*SBEN)* and social contributions (*SOC)* from other net payments from the government to the private sector; and interest paid abroad on public debt from overall transfers from the government to the RoW.

Net export (NX) is disaggregated according to

14) $NX = XGS - MGS$

15) $XGS = XG + XS$

16) $MGS = MG + MS$

We next link all variables in euros to quantity indexes, where we append a *K* to variable names to refer to "real" variables:

17) $PX = ppx \cdot PXK$

18) $XG = pxg \cdot XGK$

19) $XS = pxs \cdot XSK$

20) $MG = pmg \cdot MGK$

21) $MS = pms \cdot MSK$

22) $G = GCC + GIC + GI$

23) $GCC = pg \cdot GCCK$

24) $GIC = pgcf \cdot GICK$

25) $GI = pg \cdot GIK$

26) $GK = GCCK + GCIK + GIK$

27) $YD = YP - DT - Trpw$

28) $YDK = YD / ppx$

29) $GPK = GDP / pgdp$

where *YDK* measures real disposable income. Accounting identities for the labor market are

30) $POP = LF + RET + NLF + POPY$

31) $LF = N + U$

32) $ur = U / LF$

This concludes our accounting setup.

In the current specification, the accounting part of the model depends on the following variables:

a) Components of aggregate demand that will be modeled through the econometric specification discussed below: private expenditure; imports; exports

b) Labor market variables, some of which are determined through econometrics (employment and unemployment, and hence the labor force; retired people) and some of which will be projected exogenously (population growth)

c) Prices and relative prices, some of which will be determined through econometrics (import and export prices), while others will be kept as exogenous, although future model specification could take them into account

d) Fiscal policy variables: these will be used as policy instruments for conditional forecasts, although some variables that are only partially under the control of the government, such as payments for social benefits, will be endogenized appropriately. Other fiscal policy variables include government expenditure on goods and services—separated into individual and collective consumption, government investment, current transfers other than interest payments,

all ex post implicit tax rates, and net transfers on capital account. Interest payments on the existing stock of debt are endogenous, given the relevant ex post interest rate. The surplus of government enterprises is also projected exogenously.

e) Interest rates: at present, we only use the ex post implicit interest rates on public debt and foreign debt, which are exogenously determined.

f) Determinant of Greek exports: we chose to use the real GDP of Germany as a proxy for the income variable of the trade partners of Greece, and the deflator of private expenditure in Germany as the proxy variable to compute competitiveness of Greek exports on foreign markets.

g) The share of government debt held abroad is exogenously determined.

h) Other variables of less importance are also exogenous, such as other net payments from abroad other than interest payments or compensation of employees, etc.

2. The Data

As we noted in Papadimitriou et al. (2012), the specification of a model for the Greek economy had to address severe problems related to the availability of data. Our core dataset is derived from the national accounts and the nonfinancial sectoral accounts, both published by the Hellenic Statistical Authority (ElStat from now on), and the sectoral financial accounts published by the Bank of Greece. The accounts for the real sector are available from 2000 onward, with a statistical break in 2005 making the data from 2000 to 2004 not comparable to later data, according to ElStat. We have tried to address the 2005 break in the data with appropriate dummy variables in our econometric specification, but they have (usually) turned out to be of either small or no significance.

We used annual data from the European Commission's macroeconomic database (AMECO) and the International Monetary Fund to estimate national accounts backward. This required seasonal adjustment of the data published by ElStat,[3] quarterly interpolation of the AMECO series prior to 2000, and finally backward estimation, which for some series—such as GDP and its components—is available back to 1960, while others—mainly government accounts—could only be traced back to 1988. Some series, such as disaggregated trade, could be updated backward more precisely using Eurostat quarterly data.

Original data have been used to create model variables, yielding strong stock-flow consistency and

3 We are aware of a potential problem in adjusting for seasonality series that contain a break, but non-seasonally-adjusted data would be more complex to estimate backward. As more reliable data is published by ElStat, our procedure should produce better-quality data.

simplicity, so that, for instance, we simulate real GDP from the sum of its components, thus generating a small discrepancy on data measured at chained prices, and model the discrepancy so that our projections can refer to the published figure for real GDP.

Major stocks in the model—that is, the stocks of government debt, net foreign assets, and net financial wealth of the private sector—are estimated at costs by cumulating the relevant flows. When we then compare our results with the corresponding variables at market prices, published by the Bank of Greece for a short time period, the results are satisfactory. They are detailed below.

3. Econometric Specification

As we have shown in Papadimitriou et al. (2012), the Greek economy's financial balances were relatively stable up to the 1990s but drifting toward instability at the beginning of 2000. If we had used only the 2000–12 sample in our econometrics, it would have generated parameters that would necessarily imply instability for our intermediate-run simulation period. To avoid this problem, we first eliminated the seasonal components from the ElStat data, and then projected them backward, using (interpolated) annual data from Eurostat and the AMECO databank.

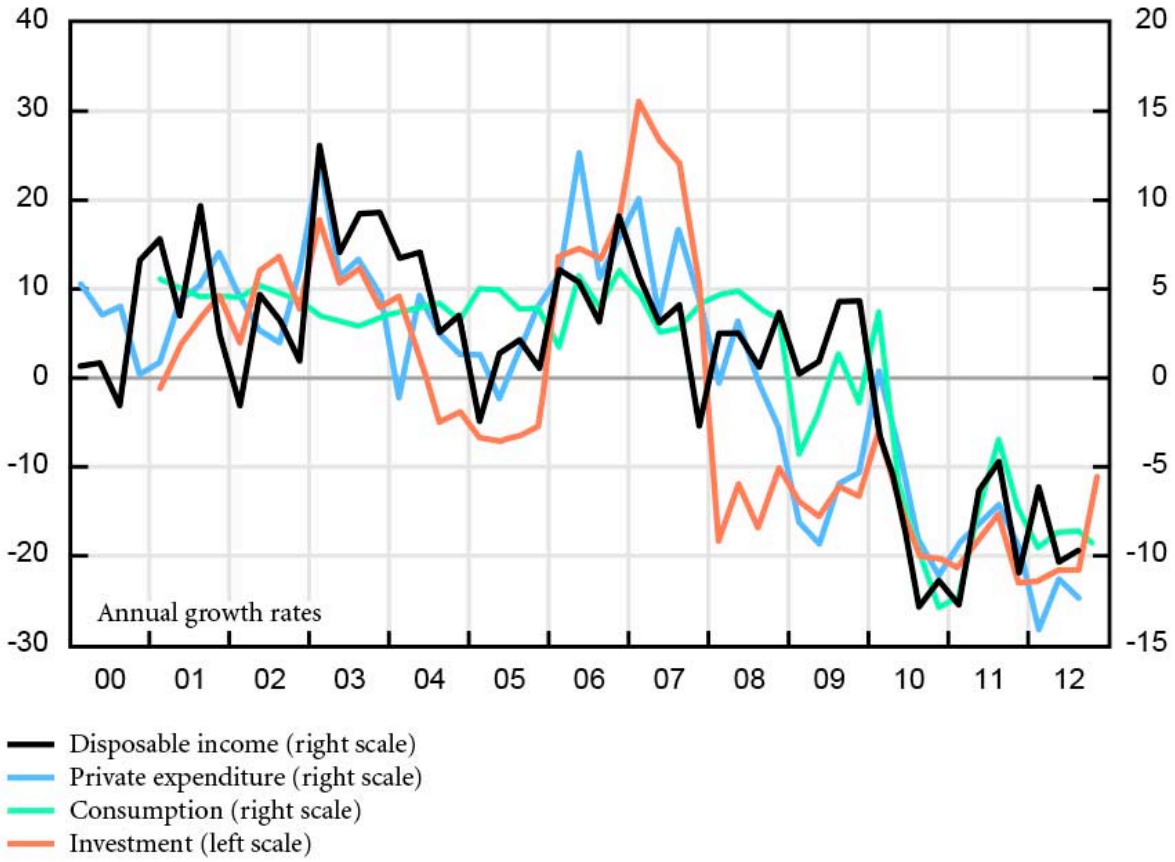
Components of aggregate demand: Private expenditure

The model is demand driven, with government expenditure exogenously determined by the government. The core "behavioral" relationship, which is the crucial determinant of the multiplier, is given by the private expenditure function. Following the New Cambridge tradition, we estimate the relations between real private expenditure (*PXK*), real disposable income of the private sector (*YDK*), and (the opening value of) the real stock of net financial assets (*FA*). Should the estimate produce stable parameter values, they will imply a ratio of financial assets to income toward which the economy is converging; the (temporary) impact of additional expenditure determinants, such as asset price bubbles, we capture with additional stationary variables. In symbols,

33) $PXK = f(YDK, FA/ppx, other)$

In Figure 1, we report the combination of growth in real disposable income and real aggregate expenditure, which is very strong both in levels and growth rates. The chart shows that in some periods in the middle of the recession of 2008–09, private expenditure fell more than would be implied by income, while in other periods, as in 2005–07, it rose more than can be justified by income. This preliminary analysis confirms the need for additional variables to explain deviations from a stable expenditure/income norm.

Figure 1 Greece. Real consumption, investment and disposable income

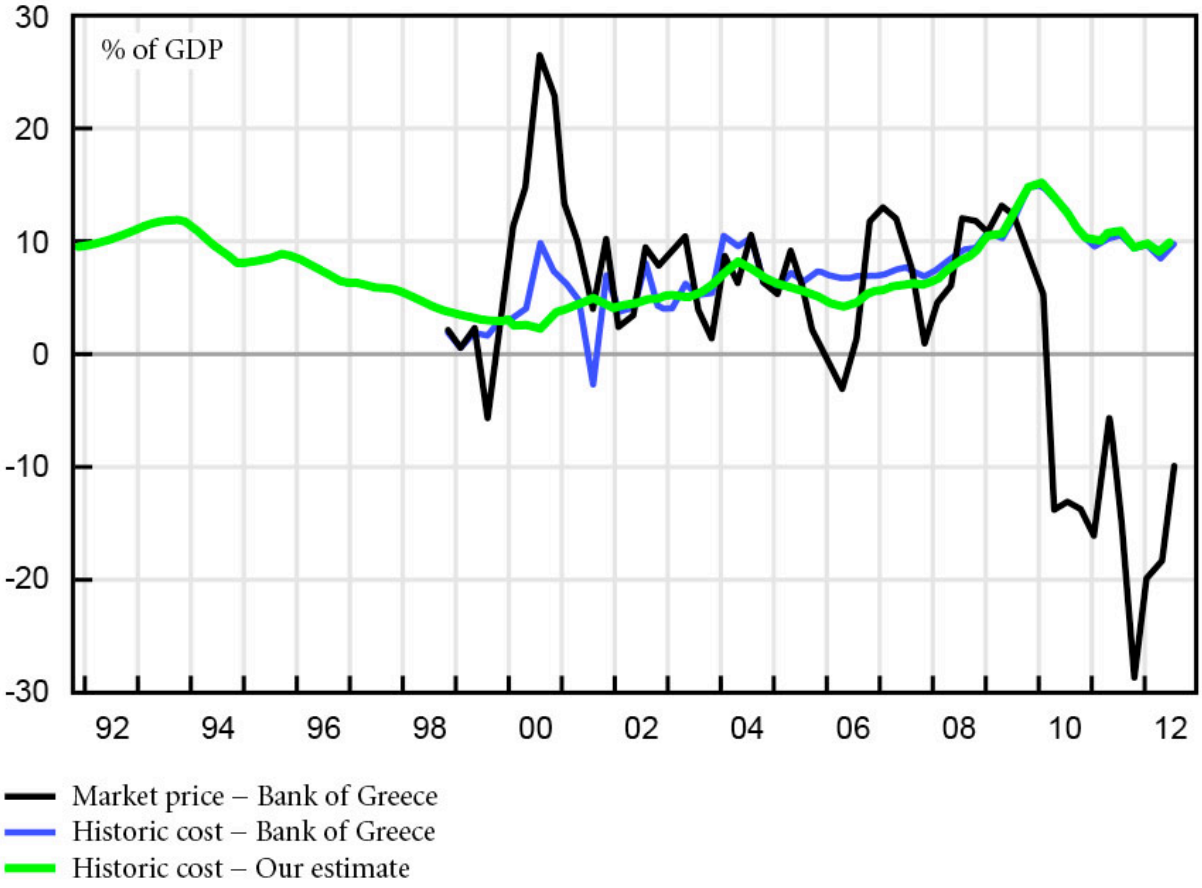


Sources: ElStat; authors' calculations

Note that we adopt a definition of disposable income such that it can be exactly divided between private expenditure and the net increase of financial assets of the private sector. However, this definition includes capital transfers that are not always relevant for expenditure. This is the case, for instance, of a large capital transfer from the Greek government to the banking sector in 2012 to rescue a failing bank. We tested the effect of such capital transfers on expenditure and, finding no correlation, decided to use real current disposable income as the determinant of expenditure, and estimated the change in net financial assets by adjusting, exogenously, for net capital transfers.

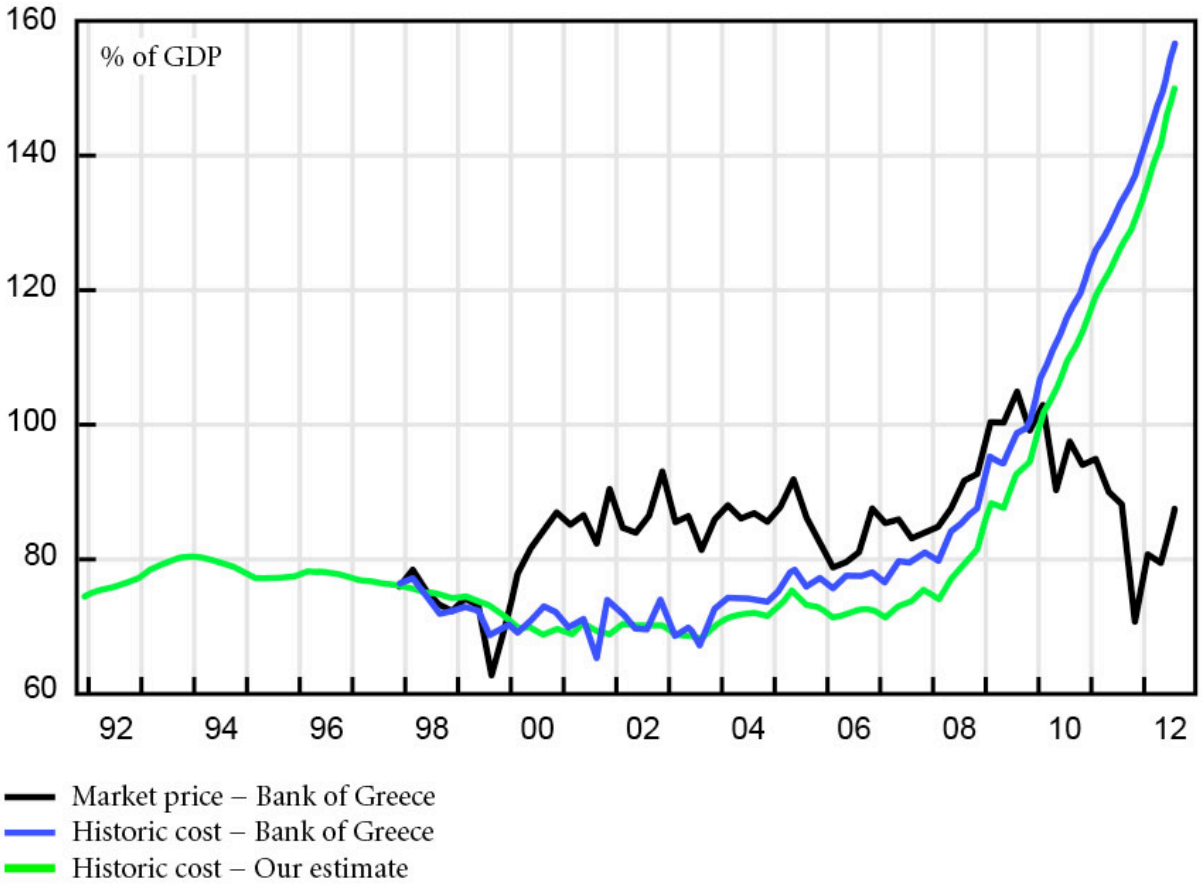
To verify our New Cambridge approach, we derived a quarterly estimate of net financial assets of the private sector, which by accounting definition must equal the sum of public sector debt and net financial liabilities of the rest of the world. As discussed in Papadimitriou et al. (2012), we obtain these estimates at costs by cumulating the relevant flows; that is, net saving of the private sector as a whole.

Figure 2a Greece. Annual change in net government liabilities



Sources: ElStat; Bank of Greece; authors' calculations

Figure 2b Greece. Net government liabilities



Sources: ElStat; Bank of Greece; authors' calculations

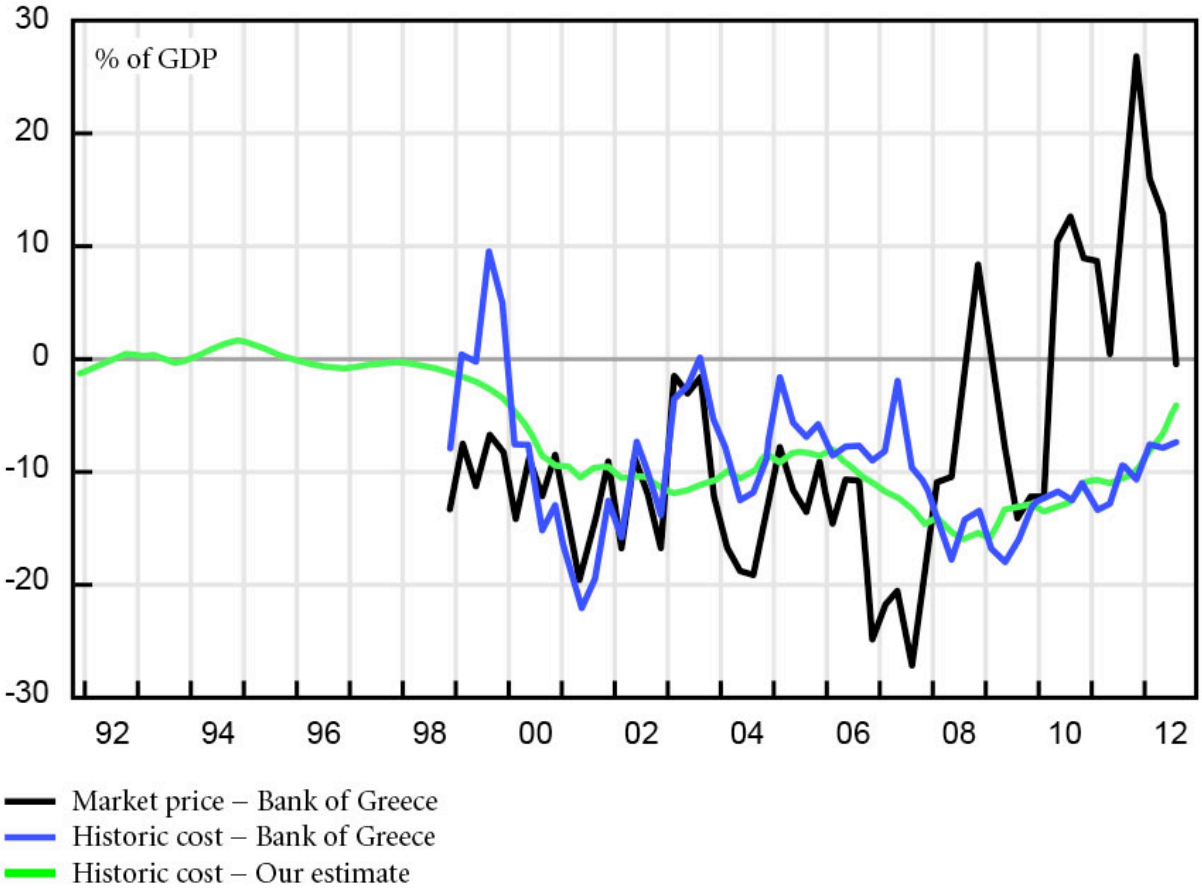
In Figure 2a, we compare our estimate of the change in net government liabilities (over the same quarter of the previous year) with the identical flow measure published by the Bank of Greece, labeled "Historic cost – BoG." The discrepancy between the two measures reflects the fact that national and sectoral accounts published by ElStat, which are behind our estimate, are not entirely consistent with the Bank of Greece measure, which uses different sources. However, the two measures at historic cost have a similar pattern, validating our own process of data reconstruction. The third measure, labeled "Market price – BoG," reports the change in the *stock* of net government liabilities over one year, as published by the Bank of Greece. This last measure will include changes in the market value of government liabilities as well as "haircuts," and will therefore be more volatile and fluctuate around the historic measure in "normal times." It has decreased, predictably, with the 2012 "haircut," which by construction has no effect on the measure at historic cost.

We have tried alternative estimates of our measure at costs that include the haircut (i.e., including a one-time decrease in the stock of debt) but the resulting measure does not seem to be consistent with the published figures for the flows of interest payments. We have therefore preferred to keep a simpler

approach, while waiting for longer-term and more reliable data.

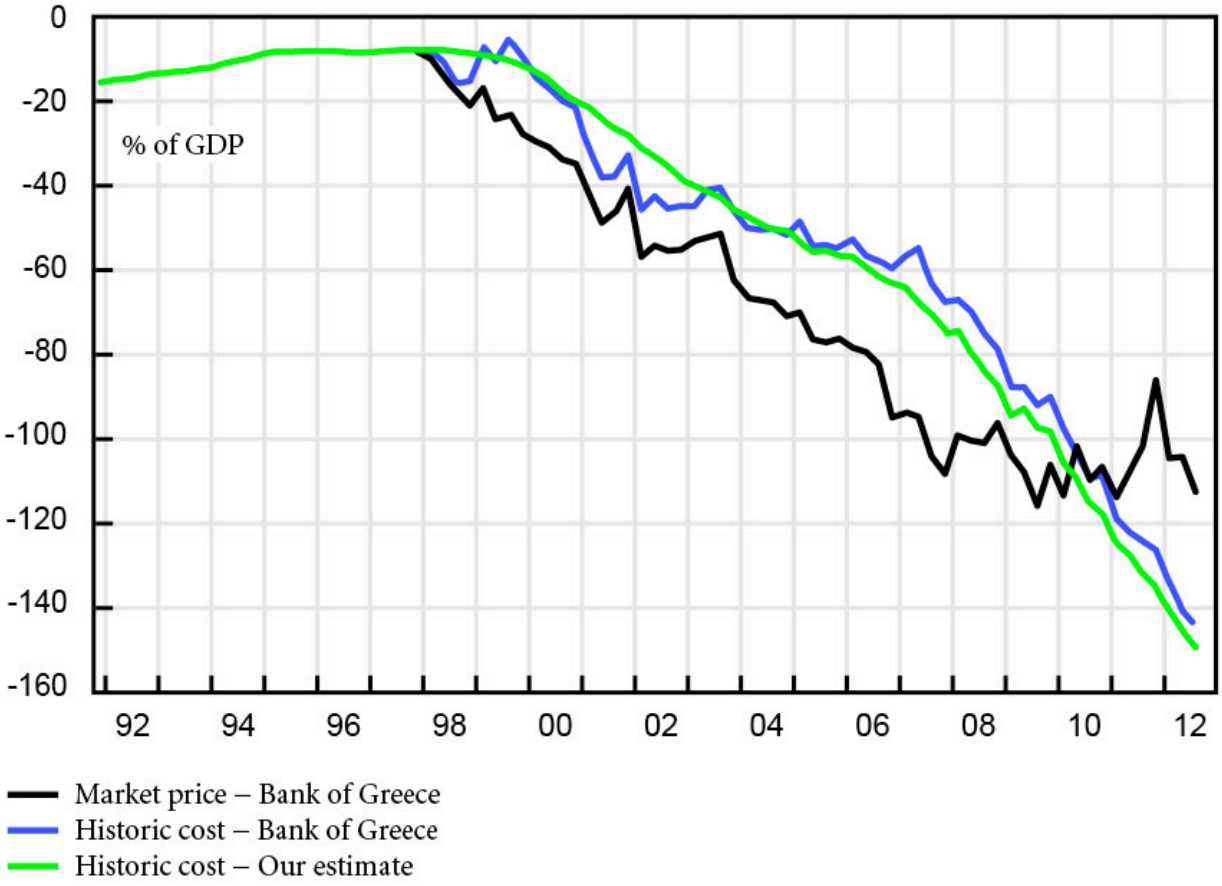
In Figure 2b, we report the stocks of net government liabilities implied by the three flow measures discussed above. The discrepancies between ElStat and BoG flow measures shift at the end of 2003, leaving a stable gap between the two measures.

Figure 3a Greece. Annual change in net foreign assets



Sources: ElStat; Bank of Greece; authors' calculations

Figure 3b Greece. Net foreign assets

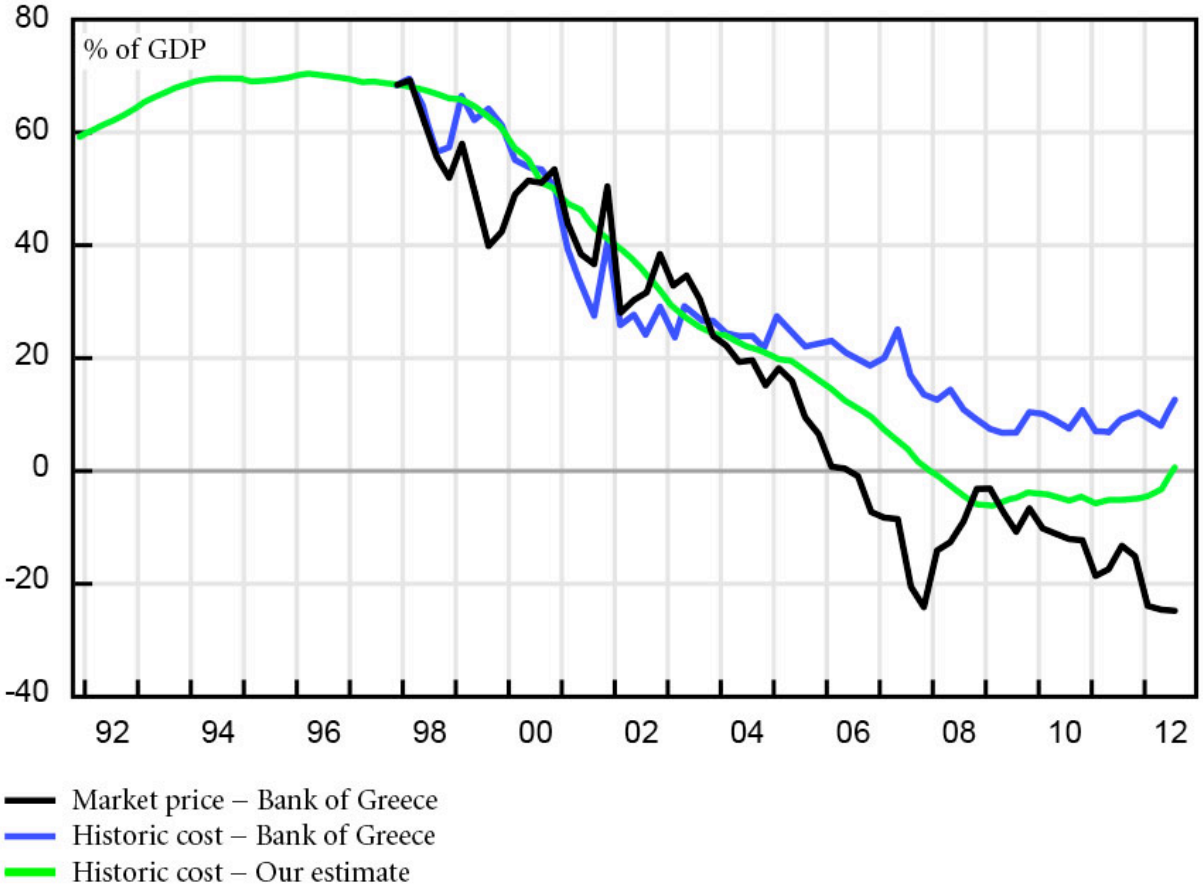


Sources: ElStat; Bank of Greece; authors' calculations

In Figure 3a, we report the flows relative to the second component of the net financial assets of the private sector—that is, net foreign assets. Again, the discrepancies between the two measures at historic cost reflect different sources used by ElStat and BoG in constructing their statistics, while the difference between data at historic cost and market prices in recent years is due to the haircuts on government debt and fluctuations in the market value of Greek assets held abroad.

By accounting identity, we obtain the stock of net financial assets of the private sector reported in Figure 4. As noted in Papadimitriou et al. (2012), the measure of net financial assets of the private sector obtained from ElStat shows that this sector is now in a net debtor position, while the same measure from BoG data is more optimistic, with financial assets still in positive territory. Comparing these measures with the stock of government debt in Figure 2b, however, it is quite clear that, even with the more optimistic measure of financial wealth of the private sector, it is not conceivable to reduce the stock of government debt by appropriating financial assets from the private sector.

Figure 4 Greece. Net financial assets of the private sector

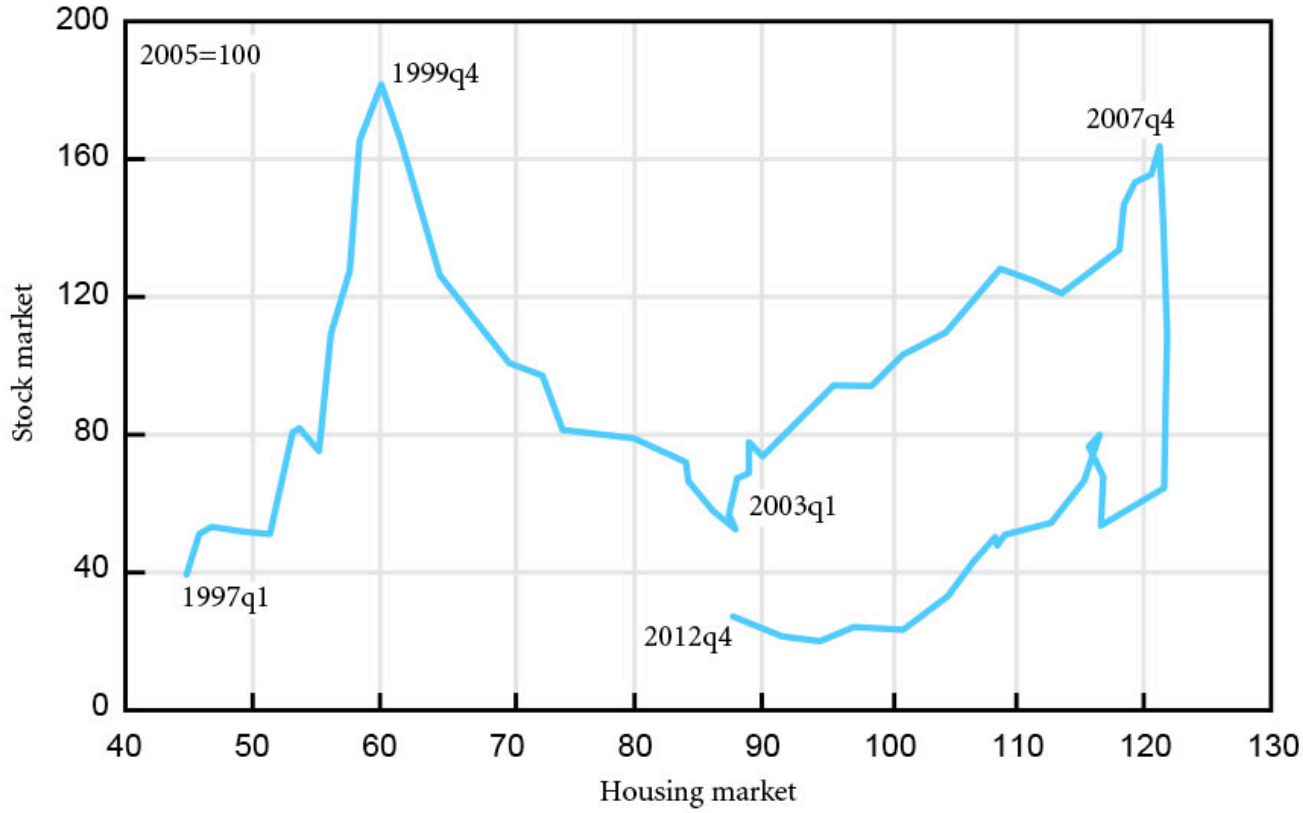


Sources: ElStat; Bank of Greece; authors' calculations

Our econometrics show that the New Cambridge approach, which implies that the link between private expenditure and disposable income can be expressed as a wealth adjustment function, has empirical evidence for the Greek economy. However, the economy can wander away from its target wealth-income norm, even for prolonged periods of time, because of net capital gains on assets or other changes that boost or depress expenditure relative to income or wealth.

We have thus explored possible links between private expenditure and alternative measures of net capital gains. In Figure 5, we report two measures of the price of assets that have proven to be effective indicators for capital gains in our model of the US economy: a price index for the stock market (from the Bank of Greece, estimated backward with data from the OECD database) and a measure of the price of existing homes, obtained from the historical series on the prices of dwellings in urban areas published by the Bank of Greece. Both indexes have been rebased at 100 in 2005. When both price measures increase in a boom, as in the 1997–99 and 2003–07 periods, they move toward the upper-right part of the chart. When they both decline, as in the 2007–12 period, they move in the opposite direction.

Figure 5 Greece. Price of assets



Sources: Bank of Greece; authors' calculations

The chart shows, clearly, that the dynamics of these indexes are different over time. A first stock market boom in the second half of the 1990s saw a moderate increase in the price of housing. With the 2001 recession, speculation moved out of the stock market and into the housing market, which increased by roughly 46 percent up to 2003, when the stock market regained confidence, and by 102 percent over the 2000–07 period. Housing prices are now back where they were in 2003, while the stock market is back at its 1996 level (not shown in the chart). The latest data show a continuous decline in the housing market, while the price index for the stock market has been rising since July 2012. Should the price of housing go back to its 1997 level, as has been the case for the stock market, home owners would experience a further drop of about 50 percent in the value of their properties, which, if it materializes, would have further adverse effects on consumption.

Given their respective trend and cycles, the two measures are not correlated. Our econometrics show a strong correlation between the stock market index and private expenditure, as detailed below, especially since 2000, while the link between the housing price index and private expenditure is not as robust, although the variable is significant.

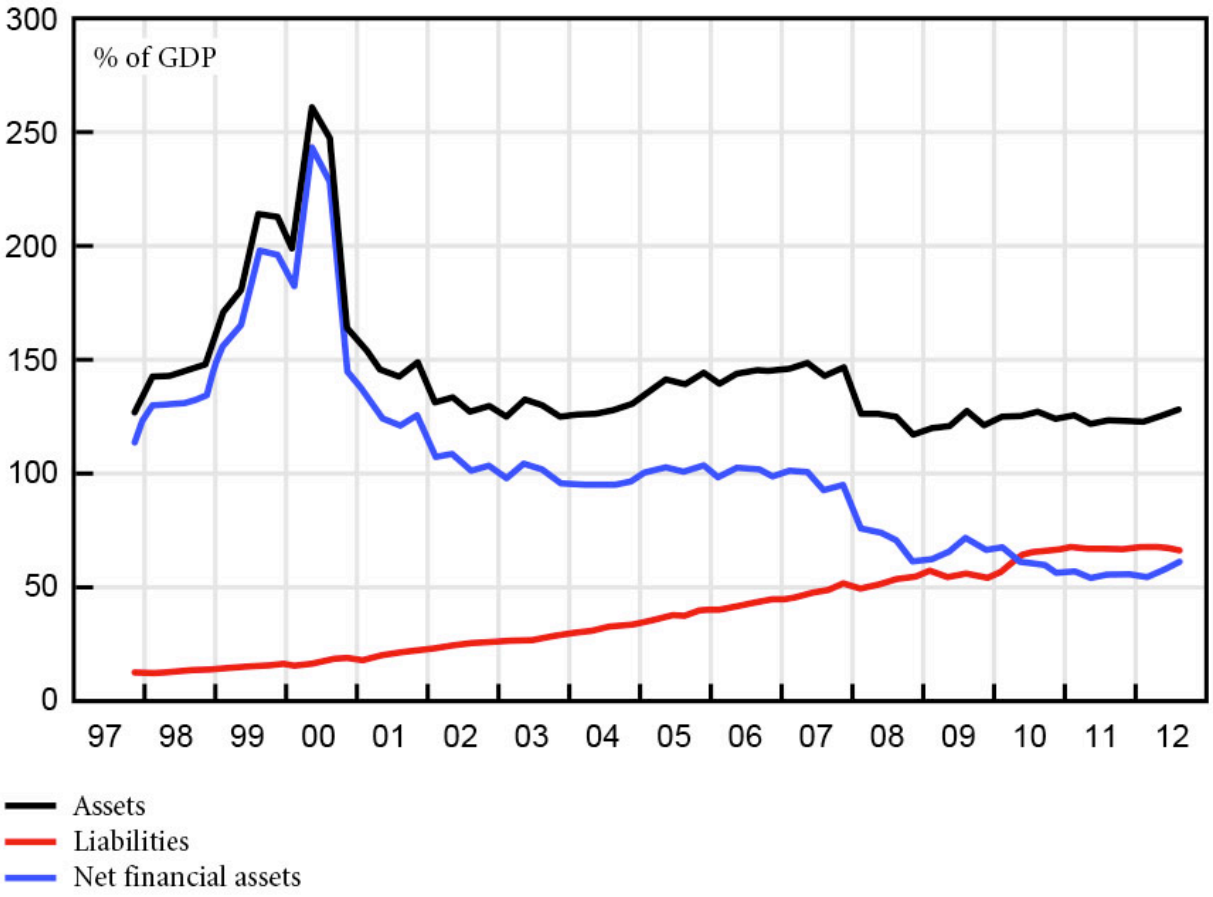
Another potential determinant of private expenditure is the availability of credit. From a theoretical

point of view, if potential borrowers are credit rationed, expenditure will be lower than desired for a given level of current and future expected income. As rationing is lifted, expenditure will increase.

In Figure 6, we report the stock of net financial assets of the household sector, as published by the Bank of Greece (the household sector includes all noncorporate business, which is relatively large in Greece). The chart clearly shows the steady increase in the stock of liabilities over the whole period up to the crisis: the flow of annual borrowing[4] grew from 2 percent of GDP in 1998 to 8.3 percent in the last quarter of 2007, at the beginning of the current crisis. This trend is, therefore, coherent with the hypothesis of debt-financed growth in consumption and/or investment from this sector. The spike in the stock of assets at the end of 1999 is coherent with the data on stock market prices discussed above: the stock market index went down by more than two-thirds between 1999 (at 182.2) and 2003 (at 52), and this largely explains the collapse in the value of financial assets held by households. A better understanding of these trends would require additional data on the distribution of wealth, since it is probable—if patterns are similar to those in other developed countries—that the owners of financial assets are highly concentrated in the top decile of the income distribution; as is known, however, most income deciles, as well as the vast majority of small businesses, borrow.

4 Measured as the change in the stock of debt over the same quarter of the previous year.

Figure 6 Greece. Financial assets of households

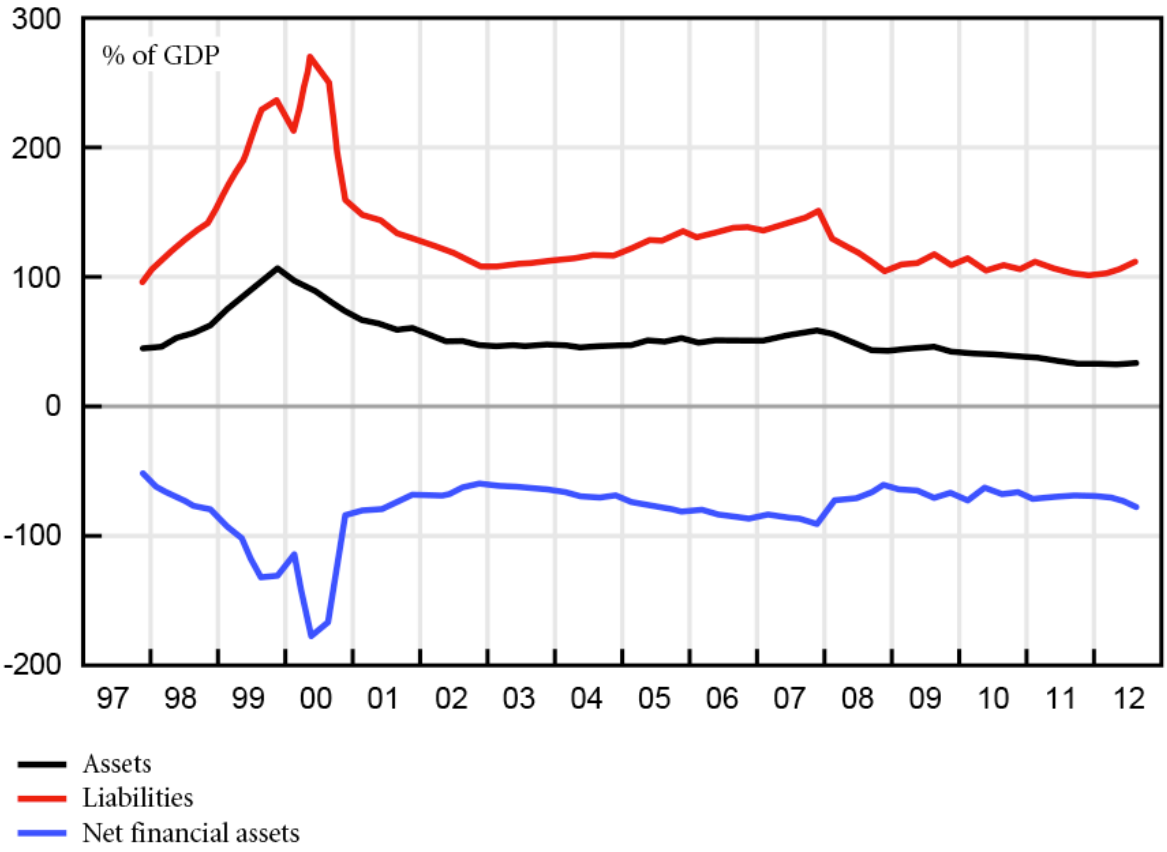


Sources: ElStat; Bank of Greece

In Figure 7, we report the same measures for corporate nonfinancial business. The overall trend in total liabilities for this sector is dominated by the change in the value of equities, but if we consider only the stock of loans outstanding,[5] annual borrowing fluctuated around 7 percent of GDP from 1998 to 2006 and started to increase more rapidly only in 2006, presumably because other sources of funds had dried up. Borrowing at a rate of 7 percent of GDP is not necessarily problematic when nominal GDP growth is around 8 percent, as was reported to be the case in Greece—on average—in the period up to the end of 2006. Borrowing of corporate businesses became unsustainable only when the recession started in 2007.

5 Measured as the sum of short- and long-term securities plus short- and long-term loans from Table 3.1L of the financial accounts published by the Bank of Greece.

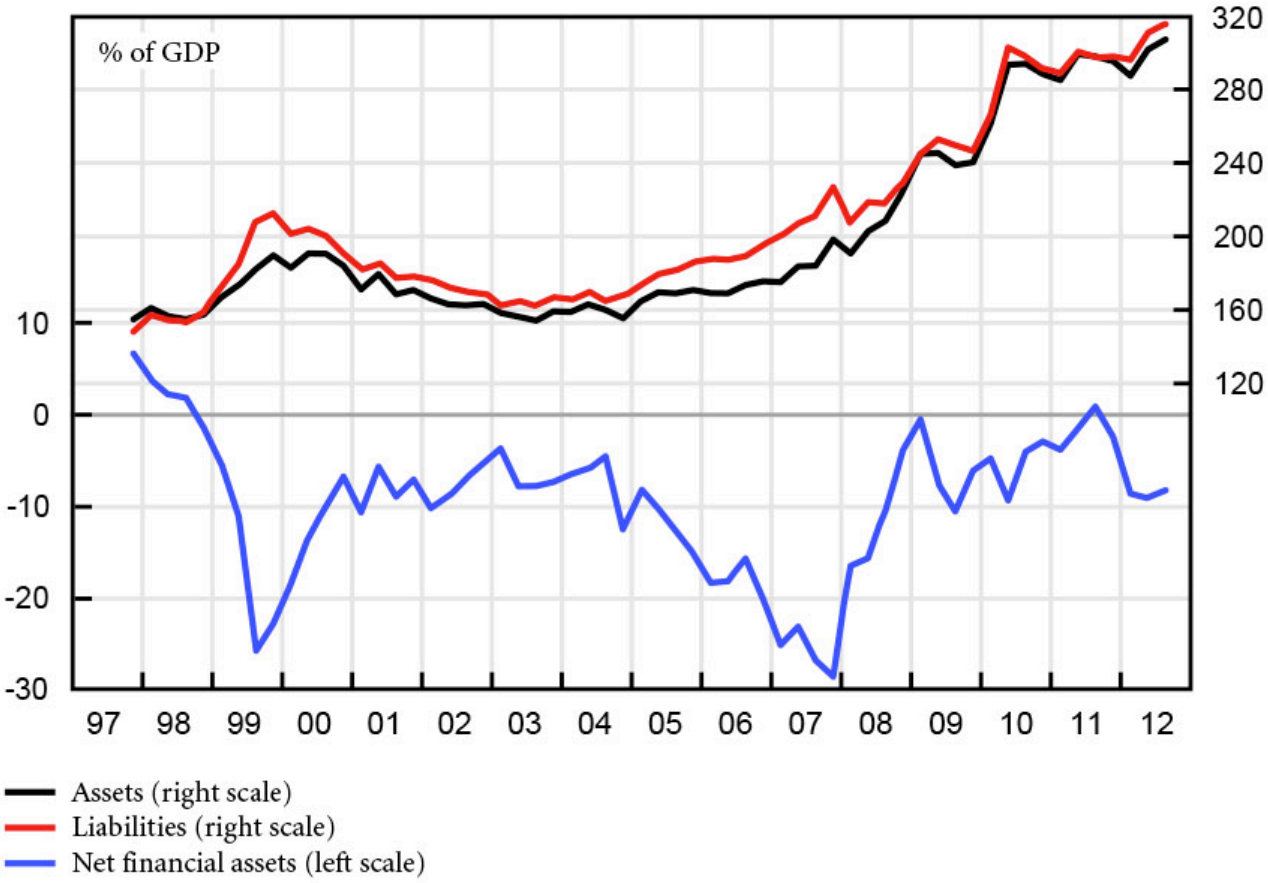
Figure 7 Greece. Financial assets of non-financial corporate business



Sources: ElStat; Bank of Greece

To complete our analysis, in Figure 8 we report the same measures for the financial sector. Note the large increase in the stock of liabilities that starts in 2004: this is mainly due to the increase in the value of equities issued by the Greek financial sector, which were once held mainly by the Greek household sector (62 percent at the end of 1997) and since then increasingly held abroad. The share of equities held by foreigners increased from 12 percent at the end of 1997 to 35 percent at the end of 2006, before the recession started, and presumably acted as part of the collateral for increased borrowing from abroad.

Figure 8 Greece. Financial assets of the financial sector



Sources: ElStat; Bank of Greece

Our preferred equation for determining private expenditure, estimated over 1988Q1–2012Q3, is the following (Table 3):[6]

6 The equation has passed Engle-Granger and Philip-Ouliaris tests for cointegration available in Eviews. The final equation has been determined through a general-to-specific approach, and nonsignificant variables are not reported. Stars indicate significance at 1 percent (***), 5 percent (**), or 10 percent (*). We have not been able so far to test for weak exogeneity of real disposable income, since we have not yet found a good set of instruments.

Table 3. Private expenditure function		
Determinant	Impact	Long-run
Real disposable income	0.34***	0.85***
Real net financial assets	0.01*	0.02*
Household borrowing	0.230***	0.587***
Stock market price	8.658**	22.069**
Price of housing	3.222*	8.213*

The equation shows that an increase of 100 euros in real disposable income implies an increase of 34 euros in private expenditure in the same quarter, and of 85 euros overall. Coefficients for real net financial assets and (real) borrowing can be read in a similar way, while the stock market price and the housing price are indexes, and therefore coefficients measure how much private expenditure would rise (in 2005 million euros) with an increase of one point in the index.

Trade

Exports are broken down between goods and services. In both cases they are determined by a proxy for the income of foreigners—which for convenience we chose to be real GDP in Germany—and by relative prices, where again we use the deflator of private expenditure in Germany as the basis to compute Greek competitiveness in foreign markets.[7]

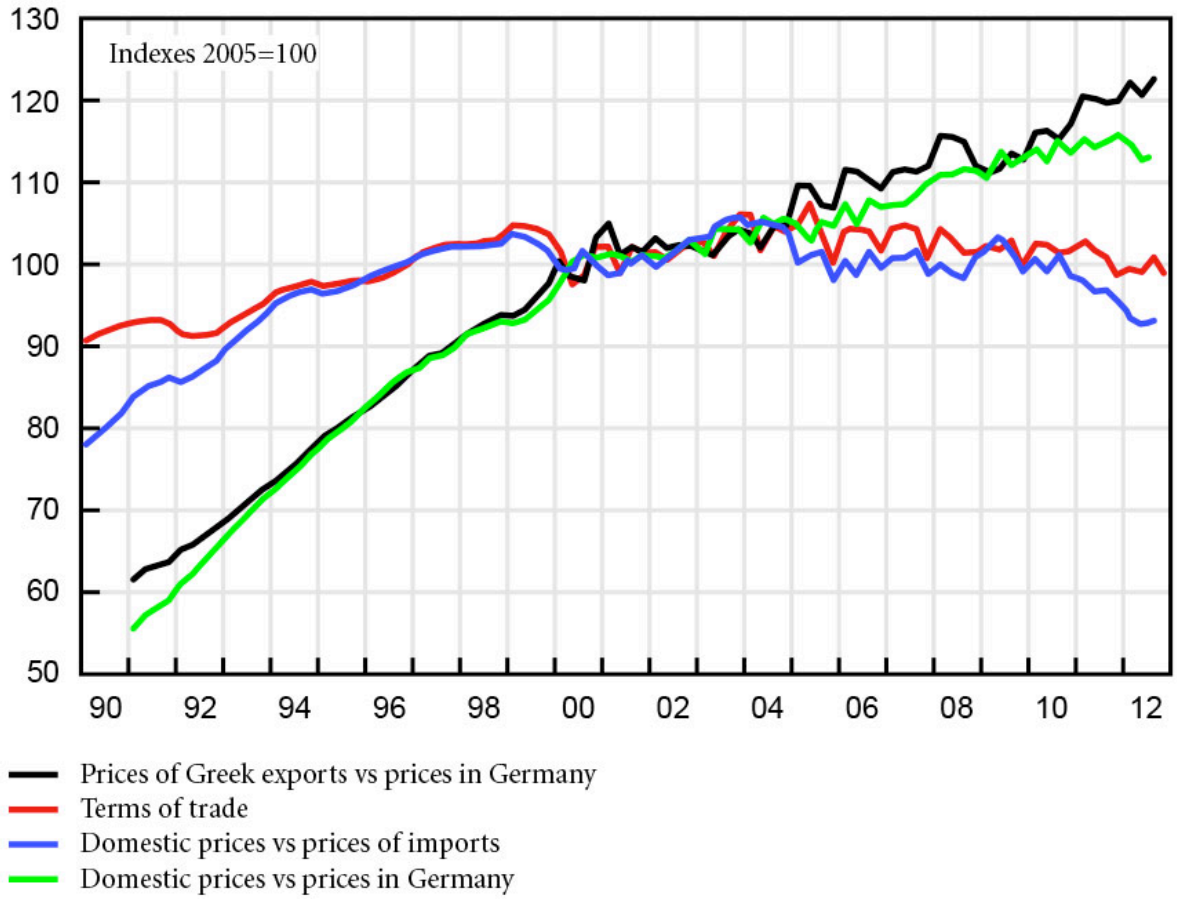
Exports of goods and services—at current prices—were a small share of Greek GDP up to the beginning of floating exchange rates in the 1970s, when they grew steadily from about 10 percent of GDP to around 20 percent, which is the average for the 1980–2006 period. With the current crisis, they dropped by 25 percent from the peak in 2008 and a trough at the end of 2009, and then started to recover. A more in-depth analysis of Greek trade has been provided in Papadimitriou et al. (2012); we just want to recall here that Greek exports have been increasing moderately against a continuous devaluation of the drachma against the deutsche mark, up to the beginning of the euro era.

When addressing the econometric specification of exports, we chose to break down the aggregate into

7 A measure of the income and inflation rate of major Greek foreign partners can be computed in future improvements on the model, but it will raise the cost of maintaining the model, as it will add several variables that need to be updated and projected for simulation.

goods and services that are likely to have different determinants. In the aggregate, some measures of price competitiveness are reported in Figure 9, which shows that, even after the crisis, inflation in Greece—as measured by the deflator of private expenditure—has been somewhat larger than in Germany, a trend that reversed only in 2012. Prices of Greek exports apparently rose even quicker than domestic prices.

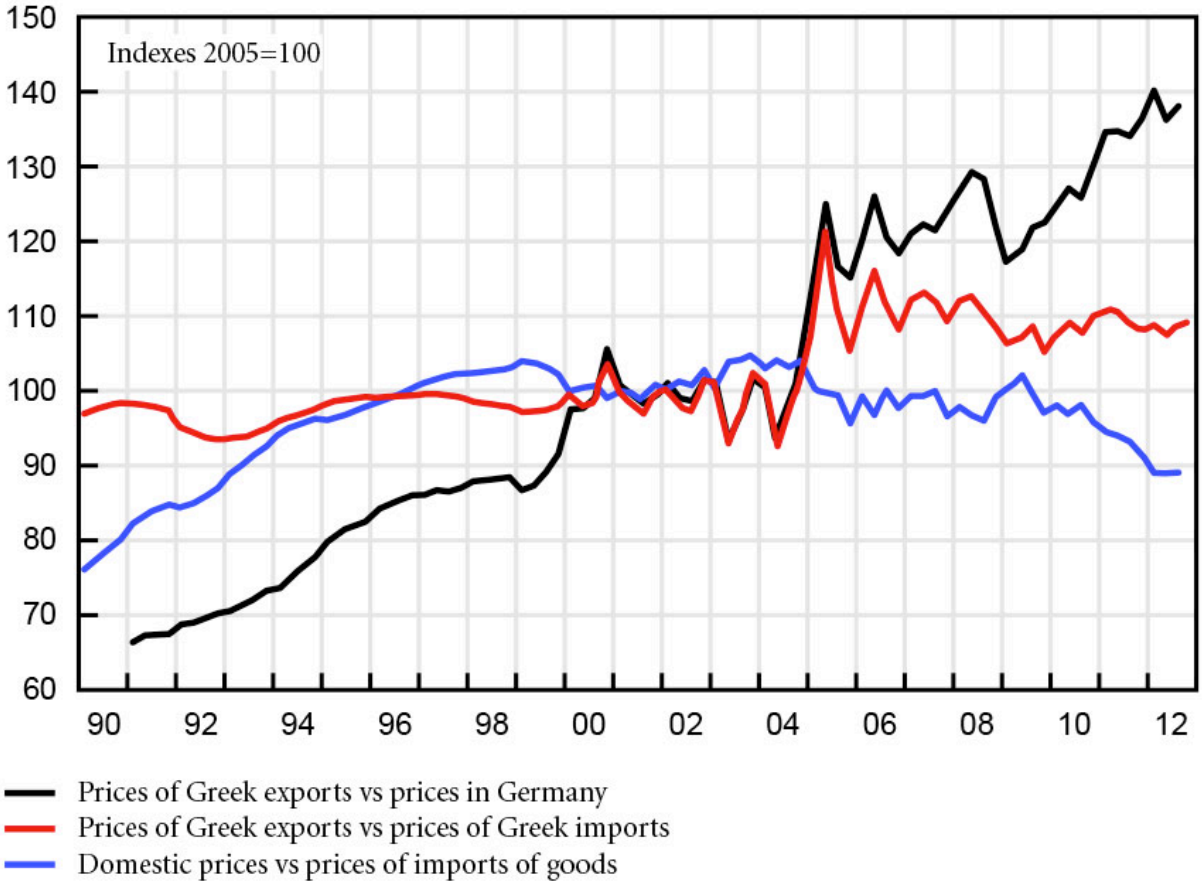
Figure 9 Greece. Measures of price competitiveness



Sources: Eurostat; ElStat; authors' calculations

When looking at the same measures separately for goods and services, we noticed a structural break in the data, possibly related to the construction of national accounts, which are not strictly comparable before and after 2005. In Figure 10, we report the same measures of competitiveness, now related only to goods. Notice the sudden jump in the price of exports relative to both domestic prices abroad and Greek imports, while no such jump occurs in the price of Greek imports relative to domestic prices.

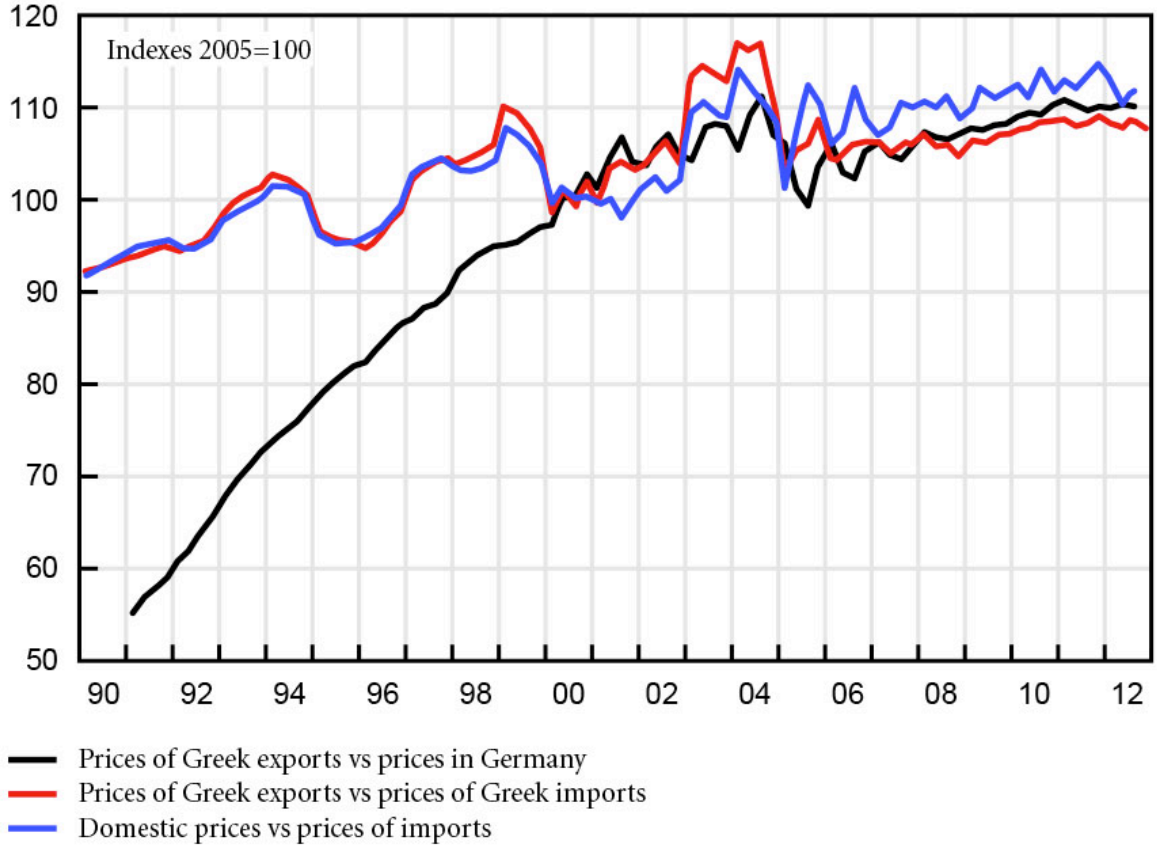
Figure 10 Greece. Measures of price competitiveness for goods



Sources: Eurostat; ElStat; authors' calculations

A jump in the opposite direction, though less pronounced, is visible in the same price measures, now related to the export and import of services reported in Figure 11.

Figure 11 Greece. Measures of price competitiveness for services



Sources: Eurostat; ElStat; authors' calculations

Notice that the price of exports of services seems to be more stable than the price of goods, when compared to measures of foreign competitors.

Given the analysis above, we used a dummy variable to test the hypothesis that the relation between exports and relative prices could shift in 2005. Indeed, we find a large price elasticity in this last part of our sample.

Our preferred equation for exports of goods has the following properties (Table 4):

Table 4. Exports of goods		
Determinant	Impact	Long-run
Real GDP in Germany	2.05***	3.17***
Relative prices	–0.25	–1.41*
Note: Coefficients measure elasticities.		

Given the presence of structural breaks, we have not been able to determine a robust cointegrating relationship among our variables, but an error correction model yields satisfactory results. The price elasticity is small and not significant before 2005, while it becomes significant after that structural break. The income elasticity seems large and in line with results for other similar countries.

Exports of services have been determined with a reasonable specification that explains their dynamics relative to an exogenous broken trend that dominates the portion of the sample we have reconstructed. A better specification will be possible when more data points are available, or whenever more precise estimates are published for the years before 2000. Our results are summarized in Table 5. We included (the lagged value of) imports of services as a determinant, since exports of services related to travel could substitute for imports, or be codetermined with imports. The latter hypothesis seems to prevail within our sample.

Table 5. Exports of services		
Determinant	Impact	Long-run
Real GDP in Germany	1.97**	
Imports of services	0.17*	0.44***
Relative prices	–0.78*	–2.02***
Note: Coefficients measure elasticities.		

Imports of goods have again been determined through an income measure—we chose domestic expenditure—and relative prices. Our specification follows an error correction approach, and the

underlying cointegrating relation seems to be robust (see Table 6).

Table 6. Imports of goods		
Determinant	Impact	Long-run
Domestic demand	1.29***	1.41***
Exports of goods	0.28***	
Relative prices	–0.20*	–0.67***
Exchange rate to the US$	–0.03	
Exchange rate to the deutsche mark	–0.19	
Note: Coefficients measure elasticities.		

Additional effects from exchange rate movements were significant in some of our specifications, so we kept them in our final preferred equation. Note that the price elasticity for imports is rather low, especially in the short run.

We suspect the existence of multiple breaks in our series for imports of services, which are therefore quite difficult to estimate. Our results are summarized in Table 7.

Table 7. Imports of services		
Determinant	Impact	Long-run
Domestic demand	0.618**	2.267***
Relative prices	–0.28	–0.63
Note: Coefficients measure elasticities.		

We have tried several econometric specifications for the deflators of exports of goods and services, so far with no success. They are, therefore, projected exogenously in our simulations.

Employment and unemployment

Employment is determined by aggregate demand and a time trend that captures productivity growth. We estimate the elasticity of employment with respect to output to be 0.5 in the long run, and only 0.08 in the short run.

At present, we project exogenously the dynamics of the labor force and compute the unemployment rate as a residual. We used some econometrics linking the unemployment rate to the dynamics of output, but results were not satisfactory, since they showed an overshooting of the unemployment rate to any change in real output.

4. Model Properties

Model properties have been assessed through simulation by shocking exogenous variables one at a time.

Fiscal stimulus

We begin with a standard Keynesian stimulus obtained through a permanent increase in (real) public expenditure, equal to 1 percent of GDP. The model projects real GDP to increase by 1.16 percent in the same quarter, and by about 1.4 percent after two years, which are therefore the short- and medium-run multipliers of the model. Employment reacts more slowly, with an increase of only 0.09 percent in the same quarter and 0.9 percent (or 39,000 jobs) after two years.

The increase in domestic demand worsens the balance of trade and the current account by about 0.3 and 0.37 percent of GDP, respectively, after two years.[8]

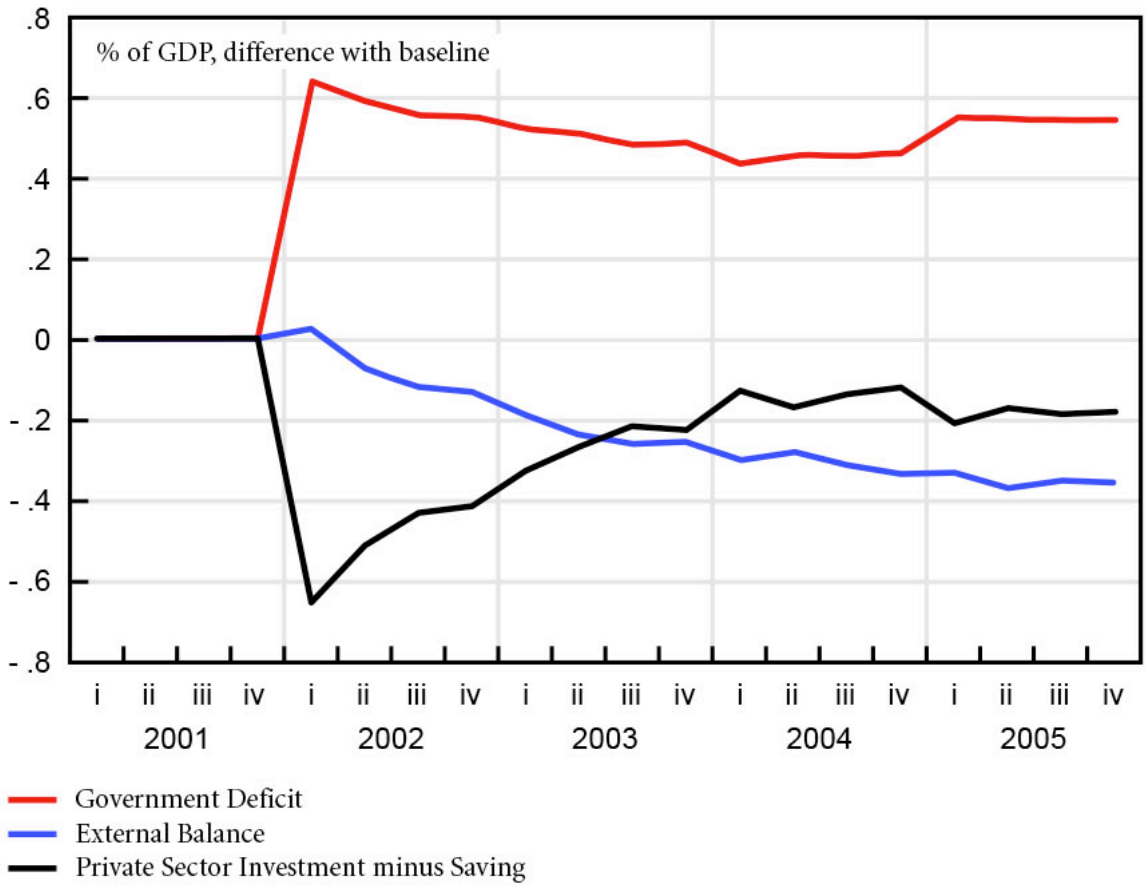
The increase in public expenditure implies an increase of about 0.6 percent of GDP in the government deficit in the same quarter, and since government expenditure is not increased any further, in the following quarters the impact on the deficit is smaller, and equal to roughly 0.5 percent of GDP. Public debt *falls* relative to GDP in the same quarter, again because the multiplier is larger than one, but since larger deficits—albeit small—are cumulated, public debt rises in the following quarters and is about 0.7 percent of GDP higher after two years.

In Figure 12, we summarize the effects of the fiscal stimulus on the main sector balances. The immediate impact on private expenditure is small, and therefore the increase in income generated from the shock to public expenditure translates almost entirely into larger aggregate saving, and the solid

8 This kind of shock has a *positive* impact on the trade balance in the same quarter, since exports do not change, and imports react only slowly to the rise in GDP, which therefore implies a reduction in the imports/GDP ratio and an improvement in the trade balance relative to GDP. As imports increase in the following quarters, the trade balance deteriorates.

black line in Figure 12 drops symmetrically with the dotted red line for the government deficit. As the increase in income generates larger private expenditure in the following quarters, the current account deteriorates.

Figure 12 Greece. Fiscal stimulus. Main Sector Balances



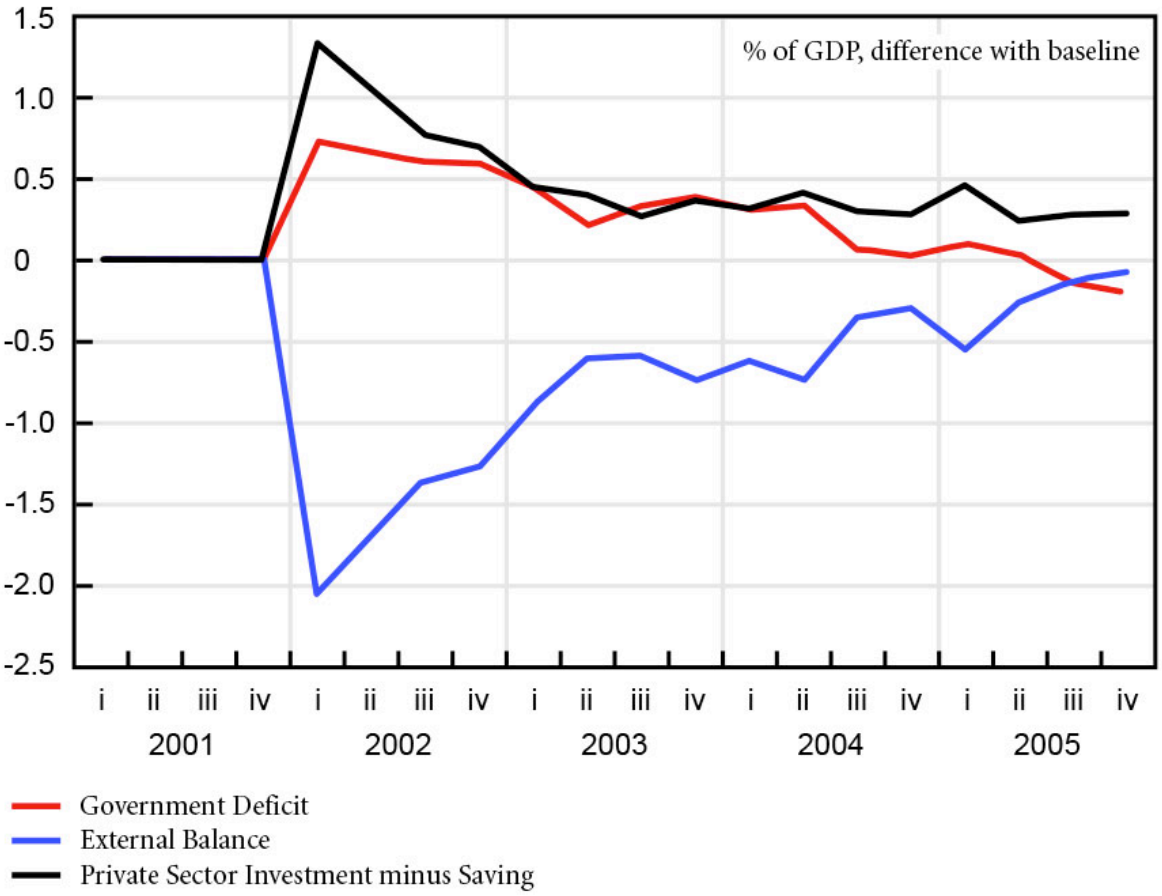
Source: Authors' calculations

Remember that in our exercises we shock one variable at a time: in this case, the model can be explored to evaluate the amount of fiscal stimulus required, say, for a target level of employment. Addressing another target, such as the rebalancing of the current account, would require a second instrument.

Internal devaluation

In our second experiment, we evaluate the impact of a fall of 5 percent of all prices in Greece relative to those of its competitors. This implies that the price of Greek exports drops relative to the prices of competitors in foreign markets, and the price of Greek imports rises relative to domestic prices, so that an improvement in the real balance of trade is achieved through an increase in exports and a reduction in imports.

Figure 13 Greece. Internal devaluation. Main Sector Balances



Source: Authors' calculations

Figure 13 summarizes the impact on main sector balances. The model produces a strong J-curve effect, mainly because the price elasticity of exports of goods is small in the short run (while the price elasticity of exports of services is higher). Real total exports increase by only 3.4 percent with the shock and by about 7 percent after two years, so that the increase in revenue from exports drops in the short run and increases only in the medium term. The drop in real total imports is small at around 1 percent with the shock, and not much larger afterward.

Real GDP improves with exports, by about 0.8 percent compared to the baseline in the same quarter of the shock, and by about 3 percent after two years. Since domestic prices are assumed to fall by 5 percent, nominal GDP will fall, with adverse consequences on the public and foreign debt-to-GDP ratios, which both increase, predictably, with the shock and decrease slowly as real GDP increases but remain higher than the baseline after two years.

It must be noted that our exercise assumes that foreign prices do not change. While this is plausible for the price of foreign goods in foreign markets, it is very likely that the price of imports into Greece—especially for services—will follow the dynamics of domestic prices, as foreign competitors attempt to

avoid losing market share. Internal devaluation may therefore be even less effective on imports than in our simulation.

5. Conclusion

In this report, we have described the main characteristics of LIMG, a model for the Greek economy loosely based on the Levy Institute model for the US economy, and firmly grounded in the New Cambridge approach and the methodology developed by Wynne Godley for building empirical models for whole countries.

The model has been built to provide a flexible tool for the analysis of policy options for the Greek economy in the medium term, keeping in mind that the analysis of a growing economy must simultaneously take into account the determinants of income and the implications of spending and saving decisions on the stocks of assets and liabilities of each of the main sectors in the economy, and the effects that changes in such assets and liabilities will have on future decisions.

A first result of our project was the construction of a database of no less than 150 variables from different sources, which have been made consistent with one another whenever possible, and estimated backward at a quarterly level. Computer programs written in Eviews allow the user of the model to update the model database in a few minutes whenever new data are released.

The model consists of 68 equations and we have focused so far on determining the major components of aggregate demand, as well as the determinants of trade and employment. The consistency between the model and sectoral accounts allows for future extensions, which may give priority to specifying the wage-determination process and inflation, which are still exogenous in the current model release.

The model has been analyzed through simulation, and the size of its multipliers seem to be reasonable and in line with other research.

The development of the model has been considerably delayed by the poor quality of the data in Greek national and sectoral accounts. Although the quality of such data has improved dramatically over the last year, most published time series at quarterly frequency are still too short for serious econometric research, and some important variables are not directly comparable among different periods. In addition, the statistical discrepancy between the national accounts published by ElStat and financial accounts published by the Bank of Greece is very large, compared to similar statistics for other European countries, casting doubts on the ability of national accounts to produce an accurate picture of all transactions in the Greek economy.

Given the quality of the underlying data, our econometric results are not yet robust, but the model has

been designed so that it can be improved upon with relative ease as data of better quality, and longer time spans, become available.

Reference

Papadimitriou, D. B., G. Zezza, and V. Duwicquet. 2012. "Current Prospects for the Greek Economy." Research Project Report. Annandale-on-Hudson, N.Y.: Levy Economics Institute. October.