The Behaviour of the Irish Economy: Insights from the *HERMES* macro-economic model

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1. Introduction

This paper explores the medium-term behaviour of the Irish economy using the HERMES macro-economic model. By changing the values of key variables in the model we can trace how these changes percolate through the model. This in turn throws light on how the economy is likely to behave in the face of changes in key external variables, such as world growth, and important policy variables, such as taxes and public expenditure.

Because of the complicated dynamics of the Irish economy we trace the effects of changes in these key variables over a period of 5 to 10 years. This allows time for the economy to return towards its long-term equilibrium level following a "shock" or perturbation in a key variable. Ultimately the speed of adjustment of the economy to changes in driving variables depends on how rapidly the capital stock adjusts to changing expectations about the future. The short-term adjustment process is also affected by the speed of adjustment of the labour market to changing circumstances.

HERMES is a medium-term macro-economic model of the Irish economy and, as such, includes a necessarily summary representation of how the key mechanisms in the economy actually work. The effects of key factors that drive the economy are estimated by perturbing a range of important variables in the model. The effects of these changes (or shocks) are then traced through the model, measuring the effects over time on key aggregates in the economy such as employment, GNP and government borrowing.

In developing the HERMES model precedence has been given to ensuring that the behaviour of the model accords with economic theory rather than to optimising its short-term forecasting behaviour. It is a structural model of the economy where the main national accounting relations and identities are explicitly specified. It assumes optimising behaviour by firms. This makes the model particularly suitable for research on the likely medium-term impact of economic policy. It is also a more suitable framework for medium-term forecasting than the simplified models that are frequently used to forecast the immediate future. The latest version of the model used here has been estimated and tested using data from the 1970s through to 2005 or 2006. The testing of the latest version of the model is described in Appendix 1 of FitzGerald *et al.*, (2008).

The paper is structured as follows. In Section 2 the key characteristics of the HERMES model are outlined. A fuller description of the model is given in Bergin et al 2009. Section 3 discusses the relevant literature which seeks to quantify the effects of policy changes on key macroeconomic variables. Section 4 briefly outlines the methodology adopted to estimate the impact of changes in different variables. Section 5 presents the results from perturbing a range of different variables in the model. Conclusions are set out in Section 6.

2. The HERMES Model

The HERMES macro-economic model of the Irish economy was first developed in the late 1980s (Bradley, FitzGerald, Hurley, O'Sullivan and Storey, 1993) [1]. Since its inception the model has undergone substantial further development to improve its treatment of how the Irish economy works, taking account of advances in economic research, and also to keep pace with the changing structure of the economy. The detailed specification of the supply side of the HERMES model made it particularly suitable for tasks such as modelling the impact of the EU Structural Funds and related investment on the Irish economy (Bradley, FitzGerald and Kearney, 1992) as well as studying the impact of EMU on the economy (Baker, FitzGerald and Honohan, 1996 and FitzGerald, 1998). It has also proved to be a suitable tool for developing consistent medium-term forecasts for the economy and for analysing the long-term impact of major policy variables, such as public investment (FitzGerald and Morgenroth, 2006).

HERMES models the supply side of a small open economy. The determination of output is modelled separately for the tradable sector and the non-tradable sector. In the manufacturing sector and the business and financial services sub-sector of the market services sector (the "tradable sector") the share of world output located in Ireland is modelled as a function of Irish competitiveness, broadly defined, relative to Ireland's competitors. This specification encompasses both Irish firms who are competing for market share on what is essentially a world market and foreign firms who choose where to locate their production to service the world market. In the model of manufacturing the demand for labour, materials and capital is then a function of Irish output, the costs of these factors of production in Ireland and technical progress.

In the original version of HERMES output in the services sector[2] was driven solely by domestic demand. More recently this specification has been revised as set out in Conefrey and FitzGerald (2008) to reflect the rapid growing importance of traded services. This revision to the business and financial sub-sector of the market services sector mirrors the specification of the manufacturing sector, with Irish output of business and financial services being sensitive to world demand and Ireland's international competitiveness, broadly defined.

The factor demand equations for the supply side of the economy together determine the aggregate demand for labour. The supply of labour is then determined by a series of equations modelling migration[3] and labour force participation. Wages are endogenous[4] and the specification of the wage determination mechanism reflects the fact that labour supply is elastic through migration.

While the original model of the labour market fitted the behaviour of the economy reasonably well in the 1980s and the 1990s, there have been changes in the behaviour

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[1] HERMES – Ireland was originally developed jointly with the Department of Finance and it replaced an earlier model, MODEL80 (FitzGerald and Keegan, 1982), used by the Department for policy analysis in the early 1980s.

[2] See Bradley, FitzGerald and Kearney, 1991 for details.

[3] Based on Honohan, 1992.

[4] The model used is set out in Curtis and FitzGerald (1996) and FitzGerald (1999) and FitzGerald and Hore (2002).

of the labour market in recent years. In particular, the changing composition of migration and the constraints in the housing market have resulted in a change in the shape of the supply curve for labour making it more inelastic.[5] These changes mean that increasing unemployment now puts some downward pressure on domestic wage rates rather than all flowing out through migration (and vice versa for falling unemployment).

More recently a detailed model of the energy sector of the economy has been added to HERMES.[6] This contains detail on the demand for energy by sector and by fuel. It also produces estimates of emissions of carbon dioxide. This sub-sector of the model is designed to feed into the Isus environmental model which, in turn, produces detailed estimates of a wide range of environmental emissions (O'Doherty and Tol, 2007).

The specification of the housing market, which is based on earlier work by Murphy, 1999, has been changed in recent years.[7] Housing completions are a function of the price of housing and the cost of building. The price of housing takes account of income, the user cost of housing, and demographic factors.

In HERMES the Irish economy is modelled as being output driven. The incomes (wages and profits) resulting from production are then spent on investment and consumption. When expenditure does not equal output in any year the difference shows up in the balance of payments current account through imports. In turn, the flows of funds into and out of Ireland through the balance of payments affect Ireland's net asset position and resulting future flows of factor income.

This specification does not ensure the long run sustainability of the economy through the balance of payments. For example, in a shock where world output is increased the current account of the balance of payments experiences a permanent improvement relative to the base. This would imply that Ireland would accumulate an ever-increasing stock of foreign assets (or repayment of foreign debts) relative to the base. This is implausible long run behaviour and it reflects the fact that in the consumption function there is no wealth effect.[8] Similarly, where a shock leads to a disimprovement in the current account balance of payments, this is not sustainable indefinitely as it would imply a continuing increase in borrowing abroad or running down the stock of overseas assets. In practise these limitations are dealt with through adjusting the model results in an ad hoc fashion to impose sustainability. However, no such adjustments have been made in the simulations reported in this paper.

In the model the exchange rate and interest rates are treated as exogenous. To examine the effects of different scenarios on monetary policy, exchange rates, oil prices etc., it is first necessary to simulate their effects on the external (world) economy. This is done by using the NiGEM world model (Al-Eyd, Barrell, and Holland, 2006). The results from such model simulations for key external variables affecting the Irish economy are then fed into HERMES to estimate the impact on

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[5] The changes in the latest version of the model to reflect this move to a more inelastic supply of labour are described in Duffy, FitzGerald and Kearney, 2005 and FitzGerald *et al*., 2008.

[6] See FitzGerald, Hore and Kearney, 2002, for details.

[7] This is described in Duffy, FitzGerald and Kearney, 2005.

[8] . If there were a wealth effect, as households' wealth increased there would eventually be an increase in consumption, moving the balance of payments back towards balance.

Ireland. This procedure is appropriate because of the small size of the Irish economy which means that whatever happens in Ireland has no appreciable effect on the Euro area economy represented in the NiGEM model.

This approach ensures that simulations that involve changes to key external variables are internally consistent. For example, a change in international oil prices will affect prices and wages in different ways in the major world economies. In turn, this will affect interest rates and exchange rates. By first simulating such a change in NiGEM the fact that an oil price change will affect Ireland through many different international channels is fully taken into account.

There are three options in the model for handling public sector behaviour. In the first option tax rates and expenditures are indexed to suitable prices so that the model reproduces a neutral fiscal policy where the government neither stimulates nor deflates the economy through fiscal policy.

In the second option, normally used for medium-term forecasting, key rates of expenditure and taxation are treated as exogenous policy variables, which are chosen by the government. In this case tax revenue depends on the exogenously determined tax rate and changes in the endogenous tax base. Similarly, where the benefit rate for those unemployed is treated as a policy variable, the total cost of benefit payments depends on the exogenous payment rate and the endogenous base (the number unemployed).

The third option forces the borrowing requirement as a share of GNP to track a specified benchmark. If that benchmark imposes long run sustainability on the public finances then, when the model is shocked or perturbed, a specified tax rate or expenditure is varied so as to ensure that the borrowing requirement tracks the sustainable path in the benchmark.

A number of important factors are not taken into account in the model. In particular, expectations in the model are backward looking. This would be an important restriction if the monetary and financial sectors were modelled as being endogenous but, as discussed above, the NiGEM model is used for this purpose, which incorporates options on forward looking expectations.

A second omission from the model is the unquantifiable effect on "confidence" of changes in key aggregates. For example, a rapid deterioration in the government's financial position could have confidence effects affecting, for example, interest rates. Such effects are not currently modelled and the results from the simulations shown below must be considered in this light. This issue is handled in an ad hoc fashion when modelling future scenarios.

3. Related Literature

Two approaches have been used in the literature to examine the impact of fiscal shocks on key macroeconomic variables. The first uses reduced form vector autoregression models while the second estimates the effect of changes to fiscal policy instruments using structural models (the approach employed in this paper). Using the first approach, Blanchard and Perotti (2002) for the United States find that a fiscal stimulus of 1 per cent of GDP increases GDP by around 1 per cent on impact and by 2-3 per cent over the medium-term. Using the same methodology, Perotti (2005) reports smaller fiscal multipliers for a sample of European countries.

Bénétrix and Lane (2009) follow the approach of Blanchard and Perotti (2002) and Perotti (2005) to identify the impact of fiscal shocks on the Irish economy. Bénétrix and Lane use a VAR specification which contains the following key variables: (i) GDP; (ii) government spending and; (iii) real exchange rate. All of the variables are expressed in terms of their deviations from the rest of the EMU countries[9]. The identification strategy adopted by the authors assumes that government spending is not affected contemporaneously by structural innovations to any other variable with the exception of government spending itself. This approach to identifying fiscal shocks is based on the strategy described in Blanchard and Perotti (2002). To identify shocks, parameters are set based on information on taxes, spending and transfers. The VAR is then estimated using these parameters which impose restrictions on the contemporaneous relationships between variables.

Bénétrix and Lane consider five measures of government spending: total government absorption; government fixed investment; government consumption; wage government consumption; and non-wage government consumption. Identification imposes the following ordering: government spending deviations, GDP differential and the real exchange rate. This implies that government spending does not respond to changes in output or the real exchange rate. Bénétrix and Lane report contrasting output responses across the different components of total government spending. They find that a positive (1 per cent of GDP) shock to total government spending generates a positive output response. However, turning to the components of government spending, Bénétrix and Lane report that a positive shock to wage government consumption has a negative fiscal multiplier. This can only happen through expectations effects which are not explicitly modeled.

Estimating the impact of fiscal shocks using a structural VAR approach has a number of limitations related to the nature and strength of the identifying assumptions required and these assumptions become stronger when annual rater than quarterly data are used. In particular, the identification assumptions imply that each of the variables in the vector of endogenous variables are allowed to respond contemporaneously to all of the variables above it, but not to any of the variables below it. This means that government spending is assumed not to react within-year to output or the real exchange rate.

As discussed by Coenen et al. (2010), this raises many possibilities for omitted variable bias and reverse causation. The authors argue that the identifying information in the reduced form VAR framework is too small to allow for an adequate treatment of important factors such as the two-way linkages between economic activity and fiscal balances, the distinction between automatic stabalisers and discretionary stimulus and leakages into imports. The pro-cyclicality of fiscal policy in Ireland over the past 25 years as illustrated in Barrett et al. (2009) highlights the importance of the link between output and government spending decisions. As discussed above, the ordering of government spending before output in a VAR model means that this channel cannot be explored using reduced form models[10].

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[9] Blanchard and Perotti (2002) and Perotti (2005) use quarterly data while Bénétrix and Lane (2009) use annual frequency.

[10] The assumption that government spending does not respond within-year to changes in output is also problematic. For example, the Irish government made two important fiscal policy interventions in January and April 2009.

Coenen et al. (2010) argue that structural models provide a more satisfactory way of quantifying the economic effects of possible policy changes. Models which have been developed and applied to the analysis of policy questions over a long period of time have embedded within them a wealth of information and empirical evidence on the structure of the economy as discussed in section 2. To the extent that this knowledge is reflected in the choice of the model structure itself, these models provide a good representation of the real economy and can be used to examine the likely effects of policy changes. While the concern exists that structural models are less transparent than simple reduced form models and represent an incomplete consensus on the structure of the economy, they avoid many of the pitfalls associated with the use of reduced form models by providing a richer representation of the channels through which policy changes affect the economy. Coenen et al. (2009) examine the impact of fiscal policy changes using seven structural models. They find that there is substantial agreement across models on the size of different types of fiscal multipliers, alleviating the concern that the structural features and calibration of models have an important bearing on results.

Finally, it has been argued (Giavazzi and Pagano, 1990) that the cut in public expenditure in the late 1980s in Ireland generated an "expansionary fiscal contraction" (EFC) as households and firms responded to improved confidence about the future arising from the return of the public finances to a sustainable path. However, as Bradley and Whelan (1997) show this hypothesis is not sustained by the data. They demonstrated that EFC behaviour is not likely, even when households and firms have forward-looking rational expectations and there are no liquidity constraints. Rather, external factors such as an increase in world growth provide an alternative explanation for the behaviour of the economy during the 1987-1989 period.

Reduced form models, such as that used in Bénétrix and Lane, play a useful role in highlighting how expectations may alter standard behavior by key agents. However, they have the disadvantage that the mechanisms whereby these changes in behavior occur are not transparent. Using a structural model, such as HERMES, while some account may be taken of how expectations are formed or changed, they may not capture all of these effects. In interpreting the results from HERMES account must therefore be taken of the fact that changes in consumer behaviour are not explicitly modelled in the consumption function. The empirical results presented in section 5 allow for a further assessment of the impact of changes in fiscal policy instruments on the Irish economy.

4. Methodology

The approach adopted in this paper is first to prepare a benchmark forecast to 2025. In this case the benchmark is based on the "World Recovery" scenario from *Recovery Scenarios for Ireland (Bergin et al., 2009)*. However, experience has shown that the results obtained are relatively invariant with respect to the precise base used. This approach has been used in the past (Bradley at al., 1993) to examine the behaviour of the model.[11]

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[11] An alternative approach to developing a benchmark, which is sometimes adopted, is to forecast forward all exogenous variables (including time) unchanged to generate the base. Then the changes are superimposed on this artificial base. While this approach has the advantage that the results are not affected

To consider the impact on the economy of changes in chosen variables, the relevant aggregates are changed one at a time by a fixed amount (for example, 1% of GNP). The model is then simulated with this one change, holding all other exogenous variables unchanged at their baseline levels. The resulting simulation results are then compared to the baseline showing the effect of the change in the relevant variable.

In carrying out these simulations all exogenous variables and parameters, other than those being perturbed, are held at benchmark levels. Of course, in the real world many exogenous variables change continuously. For example, when examining the effects of a particular government budget package many different exogenous variables may change and some crucial parameters may also be affected, for example, through the effect of fiscal policy on consumer confidence. As a result, when using the model to examine real life policy changes or exogenous shocks to the Irish economy, it is necessary to carry out a full simulation, considering the effects of the policy change (or shocks) on all the exogenous variables and parameters in the model.

Finally there are four technical considerations which are important when interpreting the results:

1. Unless otherwise specified, it is assumed that the government borrowing requirement will change as a result of the perturbation in the model. For example, where a tax rate is increased it is assumed that the additional revenue is used to reduce borrowing rather than to reduce other taxes.

2. The results shown in this note are affected by the absolute level of the interest rate in the benchmark simulation. The results, especially for GNP, are sensitive to this assumption, especially where government foreign indebtedness is high. For example, the higher the rate of interest the more important the negative offset to GNP from the debt interest arising from an increase in government expenditure. In the simulations reported here a risk premium of two percentage points is applied to Irish government borrowing for the period 2009-2010. It is assumed to decline thereafter. This reduces the impact of a change in world output and enhances the savings to the government sector when taxes or raised or expenditure is cut.

3. As discussed earlier the balance of payments is not constrained to balance in the long run and this must be taken into account when interpreting the results.

4. For 2009 and 2010 the personal savings rate is assumed to reach an exceptionally high level of around 13 percent. It falls over the period 2011-2015 back to a more normal level. The affect of this assumption is to significantly reduce the multiplier effect on the Irish economy of shocks, such as an increase in world output.

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by changing levels of key variables in the base, it raises difficulties as to how to handle inflation rates and rates of return, including interest rates. Generally in such cases interest rates and rates of return should be held fixed in real terms. Because of these problems this paper favours the benchmark approach – superimposing shocks to the model on a baseline forecast. In that regard, past experience in using the model indicates that the results of shocks or perturbations are relatively invariant to changes in the benchmark.

5. Results from perturbing the model

The results for each of the different shocks are presented for a standard set of variables in a series of tables.[12] In each case the results are presented as changes compared to the benchmark, e.g. the change in GNP resulting from the shock. These changes, unless otherwise stated, are changes in levels. Thus a change of one per cent in GNP in 2015 is a change in the level of GNP in that year.[13]

Unless otherwise specified, each shock is initiated in 2009 and the results are then examined for the period to 2015, holding the shock unchanged over that period. Generally, the discussion centres on the medium term impacts of the different shocks, concentrating on the results for 2015. However, each of the tables shows the impact effects for 2009 and the results for the intervening years.

In interpreting the results it should be noted that a positive sign denotes a reduction in the balance of payments deficit (or, equivalently, an increase in the surplus) and a reduction in the government borrowing requirement (or, equivalently, an increase in the financial surplus).

The first set of results looks at how changes in wage costs impact on the economy. The second set of results examines the effects from changing key policy variables – taxes and public expenditure. The final set of results considers changes in key world variables and how they affect the Irish economy. All of the shocks to the policy variables are calibrated in such a way as to generate €1 billion in tax revenue in 2009 from each of the instruments.

5.1 Wage Rates

Even prior to the current crisis there was extensive evidence that Ireland was losing competitiveness on world markets. Labour costs had risen continuously relative to Ireland's neighbours even before the recent fluctuations in exchange rates. Because of the building boom the tell-tale signs of impending trouble were heavily masked. However, once the building bubble burst the cumulative effects of the deterioration in competitiveness became clear. With the beginning of a world recession in 2008 the vulnerability of the Irish economy has been cruelly exposed.

At this stage it is not possible to quantify just how much costs in Ireland, including labour costs, need to be reduced to restore Ireland to full employment in the medium term. To get some feel for the likely response of the economy to a reduction in labour costs we consider an "illustrative" change in wage rates of 5 per cent compared to a base-line forecast.

With the exception of the public sector, wage rates are not a policy variable that the government can control or vary. On past experience, wage bargaining in the Irish labour market takes place in terms of real after tax wages and wage rates adjust over two or three years to their equilibrium value (Curtis and FitzGerald, 1996 and FitzGerald, 1999). In recent years there is evidence (Fitz Gerald et al., 2008) that the elasticity of labour has fallen and that, as a result, the market clearing wage rate is also affected by the state of the domestic labour market: a very tight labour market or, more recently, rapidly rising unemployment affects wage rates.

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[12] The effects on all the other variables in the model are available, on request, from the authors.

[13] It does not necessarily represent a change in the growth rate in 2015 – the change in growth could have occurred in an earlier year.

The extreme nature of the current international recession and its severe consequences in Ireland in terms of unemployment may mean that wage rates in Ireland may change more rapidly than in the past to restore competitiveness.

While. on the basis of the past behaviour of the labour market, the prospect of a substantial decline in the price level would hold out the promise of a significant fall in nominal wage rates, as participants in the labour market bargain in terms of real after tax wage rates. Past experience would also suggest that this would take a number of years to complete. However, while this is the implication of the standard model, we have not previously experienced a period when the price level fell by a significant amount. There is, as a result, considerable uncertainty as to whether nominal wage rates will actually fall as the existing model would suggest. There is very limited experience in OECD countries of this happening in the post-war years. If instead of nominal wage rates falling they were to mark time till equilibrium was restored to the labour market, this could take some considerable time, given the underlying low rate of inflation in the Euro area. Such a delay in adjustment in wage rates would shift the burden of adjustment onto employment leading to higher unemployment.

In this simulation we consider the impact of a change in the level of non-agricultural wage rates in 2009, with this reduction in the level of 5% relative to the base being maintained for the full period to 2015. If instead of being concentrated in 2009 the change was spread over a period of five years as a gradual fall in wage rates, the long-term beneficial impact on employment and unemployment would be delayed two or three years compared to the results shown here.

Table 2: 5% fall in nominal wage rates, change relative to baseline

		2009	2010	2011	2012	2013	2014	2015
Percentage change relative to benchmark	%							
GDP	%	0.0	0.7	1.1	1.3	1.4	1.5	1.6
GNP	%	-0.6	-0.2	0.3	0.6	0.7	0.9	1.0
Consumption	%	-1.6	-1.5	-1.6	-1.4	-1.3	-1.3	-1.2
Average Non-Agricultural Earnings	%	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
Consumption Deflator	%	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8	-0.8
Total Employment	%	1.0	1.4	1.8	2.0	2.2	2.3	2.4
Labour Force	%	0.0	-0.6	-0.9	-1.0	-1.0	-1.0	-1.0
Output Manufacturing	%	0.3	1.4	2.1	2.4	2.6	2.7	2.8
Output Services	%	0.1	1.0	1.2	1.4	1.5	1.6	1.7
Absolute change relative to the benchmark								
Unemployment rate, ILO Basis	Percentage Points	-0.9	-1.7	-2.3	-2.6	-2.8	-3.0	-3.1
Balance of Payments	% of GNP	-0.2	0.5	0.8	0.9	0.9	1.0	1.0
General Government Balance	% of GDP	0.1	0.3	0.5	0.6	0.8	0.8	0.9
Borrowing Requirement	€million	465	690	960	1131	1424	1648	1837

The simulation takes no account of any wider confidence effects which might arise from urgent action being taken to tackle Ireland's twin problems of competitiveness and government borrowing. If, for example, the risk premium on government borrowing were to fall as a result of this action, this would magnify the long-term economic benefits shown here.

The potential impact of this cut in wage rates on a range of key variables is shown in Table 2. The economy would take time to adjust to such a sudden change. Firstly Irish and foreign firms would take time to realise that Ireland is a better place to do business as a result of the change. It would take time for the cut in wage rates to feed through into the prices of domestic inputs – e.g. energy. Then it would take time for businesses, foreign or domestic, to decide to expand in Ireland. Finally, it would take time to put in place the new capital – offices, factories and equipment - so that the new businesses could get up and running. As a result, the long-term effects are best considered by concentrating on the results for 2013-2015.

The cut in wage rates would have a positive impact on economic activity, employment and the public finances in the medium term. The simulation indicates that the improvement in competitiveness brought about by the wage cut would increase GNP by around 1 percent by 2015. As indicated above, the initial impact would be very small (with an actual fall in the first year) as it would take time for the economy to adjust. The bigger drop in GNP relative to GDP in the first year would reflect the fact that the initial impact of a fall in wage rates on foreign owned firms would be to increase their profitability (or reduce their loss of profitability). However, in the longer run this increased profitability would drive increased investment, output and employment in Ireland.

Improved competitiveness would result in increased output in manufacturing and market services. Ultimately GDP arising in manufacturing would rise by around 3.0 per cent as a result of the improvement in competitiveness. The increase in the output of the market services sector would be around 1.7 per cent by 2015.

In turn, the rise in output would give rise to an increase in employment. Total employment would be up by 2 per cent by 2012. The effect on labour supply would be quite uncertain because of the unusual external environment – a recession in all other labour markets. In this simulation a fall in the labour force of 1 per cent is shown because of increased net emigration (or reduced net immigration) and reduced labour force participation, consequent on the assumed reduction in real after tax wage rates in Ireland. The model assumes that the lower unemployment rate would partly offset the reduction in real after tax wage rates in Ireland, moderating the impact on migration. This is taken into account in the results in Table 2.

The fall in unemployment of around 3 percentage points by 2013 would reduce government welfare payments. The across the board cut in wage rates would also reduce the cost of the public sector pay bill, as public sector wage rates are assumed to adjust in line with wage rates in the private sector. On the revenue side, while initially lower incomes would reduce income tax receipts, the growth in employment and business activity would result in a substantial rise in government revenue from a range of taxes in the medium term. The exchequer borrowing requirement as a percentage of GDP would fall by around 0.9 percentage point by 2015.

There would be a substantial improvement in the balance of payments as a result of this shock (1.0 percentage point of GNP). In the very long run this would imply an increase in wealth for the Irish private sector as it accumulates assets abroad (see Box in Winter 2008 *Quarterly Economic Commentary*). This would imply that the long-term benefits for the economy would be greater than shown here, especially if there were wider confidence effects.

Finally, the cut in wage rates would result in a fall in consumer prices of around 0.8%. This fall, though limited, would moderate the fall in real wages as a result of the cut in nominal wage rates.

5.2 Once off cut in public sector pay rates

In this simulation we consider the impact of a 3.9% fall in nominal wage rates in the public sector, all implemented in 2009. This would have reduced the public sector pay bill by €1 billion in 2009. Wage rates in the private sector are assumed to be unaffected by the fall in public sector rates. As in the previous simulation, the reduction in expenditure is used to moderate the increase in the national debt. In this simulation we also assume that there is no "demonstration" effect on wage rates in the private sector. If such a knock-on effect were to occur, the results for the economy would lie somewhere between the results presented here and the results for an economy wide wage cut presented in Section 5.1.

The cut in public sector wage rates would result in lower incomes and would reduce government tax revenue. The overall impact would be a net improvement in the exchequer borrowing requirement of €560 million by 2015 or 0.2 per cent of GDP.

The fall in wage rates would lead to a reduction in consumption and a lower level of demand in the economy. In turn, this would impact on the output of the market services sector. Assuming that there is no response by private sector wages, there will be no direct impact on competitiveness. As a result, output in the rest of the economy would not respond and the cut in wage rates would lead to a reduction in GNP of 0.5% by 2015. With tax rates held constant there would be no impact on consumer prices. The reduction in consumption would see an improvement in the balance of payments by 2015 of 0.3 percentage points of GNP. This increased balance of payments surplus, implying an accumulation of foreign assets by the private sector, would have a further long-term positive impact on the economy which is not taken into account here. In addition, there could be wider confidence effects not taken into account here.

Table 3: Reduction in public sector wage rates, change relative to baseline.

		2009	2010	2011	2012	2013	2014	2015
Percentage change relative to benchmark	%							
GDP	%	-0.2	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
GNP	%	-0.4	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Consumption	%	-0.9	-1.0	-1.1	-1.1	-1.0	-1.0	-0.9
Average Non-Agricultural Earnings	%	-1.4	-1.3	-1.2	-1.1	-1.0	-1.0	-0.9
Consumption Deflator	%	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Total Employment	%	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2
Labour Force	%	0.0	-0.2	-0.4	-0.4	-0.4	-0.4	-0.4
Output Manufacturing	%	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.2
Output Services	%	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Absolute change relative to the benchmark								
Unemployment rate, ILO Basis	Percentage Points	0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2
Balance of Payments	% of GNP	0.2	0.2	0.3	0.4	0.3	0.3	0.3
General Government Balance	% of GDP	0.3	0.3	0.2	0.2	0.2	0.3	0.2
Borrowing Requirement	€million	677	571	479	441	514	549	560
Public Sector Pay bill	€million	-1,000	-891	-850	-840	-867	-904	-942

The public sector pay bill (public administration, health and education) amounts to almost one third of the total pay bill for the economy as a whole. As a result, average wage rates for the economy would be reduced by 1% in 2013. Lower real after tax earnings in Ireland relative to the rest of the world would tend to encourage emigration (reduce immigration). It would also adversely affect labour force participation. Hence the labour force would fall by 0.4 percentage points. While total employment would fall by 0.2 percentage points by 2015, the net effect would be a small reduction in the unemployment rate in 2015 of 0.2 percentage points. To the extent that emigration proved impossible because of the external environment the impact on unemployment would be less benign.

As mentioned earlier, it is assumed in this simulation that there is no demonstration effect whereby private sector wage rates follow the lead of the public sector. To the extent that there was such a demonstration effect, the eventual impact on the economy would lie between the numbers shown in Table 3 and those shown above in Table 2 for an economy-wide reduction in wage rates.

As shown below the negative effects on GNP of cutting public expenditure through reducing pay rates for the public sector are likely to be significantly smaller than would be the case if a similar improvement in the borrowing requirement were achieved through cutting public sector employment and the related services.

5.3 Increase in average rate of income tax

In this shock the average rate of income tax was increased by an amount sufficient to raise €1 billion in income tax revenue in 2009. This would reduce purchasing power and consequently the volume of consumption would be 1.1 per cent below the base

(Table 4). As a result output in market services would be reduced by 0.6 per cent in the medium run. Overall GNP would fall by 0.5 per cent.

The model assumes that workers bargain in terms of their real after-tax wage rate. As a result some of the increase in the tax rate is passed on to employers in terms of higher wage demands. By 2015 wage rates would rise by 0.5 per cent. This would result in a loss of competitiveness in the Irish economy and consequently output in the manufacturing sector would fall by 0.3 per cent by 2015. Lower levels of activity in manufacturing and market services would reduce total employment by 0.4 per cent in 2009 and this would lead to an increase in the unemployment rate of 0.1 percentage points.

The increase in the tax rate would lead to a lower lever of demand in the economy and would reduce consumption and output. As a result there would be a reduction in tax revenue due to lower profits and consumption. However, the increase in the tax rate would lead directly to an increase in government revenue. The overall impact would be a net improvement in the exchequer borrowing requirement of €744 million in 2009 or 0.4 per cent of GDP.

Table 4: Increase in personal tax rate, change relative to benchmark.

		2009	2010	2011	2012	2013	2014	2015
Percentage change relative to benchmark	%							
GDP	%	-0.2	-0.3	-0.4	-0.4	-0.4	-0.5	-0.5
GNP	%	-0.2	-0.3	-0.4	-0.4	-0.5	-0.5	-0.5
Consumption	%	-0.7	-0.8	-1.0	-1.0	-1.0	-1.1	-1.1
Average Non-Agricultural Earnings	%	0.4	0.4	0.4	0.5	0.4	0.5	0.5
Consumption Deflator	%	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total Employment	%	-0.2	-0.2	-0.3	-0.3	-0.4	-0.4	-0.4
Labour Force	%	0.0	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2
Output Manufacturing	%	-0.1	-0.2	-0.3	-0.3	-0.3	-0.3	-0.3
Output Services	%	-0.3	-0.4	-0.5	-0.6	-0.6	-0.6	-0.6
Absolute change relative to the benchmark								
Unemployment rate, ILO Basis	Percentage Points	0.1	0.1	0.1	0.2	0.2	0.2	0.1
Balance of Payments	% of GNP	0.3	0.3	0.4	0.4	0.3	0.4	0.4
General Government Balance	% of GDP	0.4	0.4	0.3	0.3	0.4	0.4	0.4
Borrowing Requirement	€million	744	656	581	606	713	788	858
Income Tax Revenue	€million	1,000	934	900	950	1,019	1,106	1,192

In the long run the balance of payments would improve by 0.4 percentage points of GNP as a result of the shock. This would reflect the deflationary impact of the tax increase. In the long run this improvement in the balance of payments would hold out the potential for offsetting gains in terms of GNP.

5.4 Increase in carbon tax on non-tradable sector[14]

In this perturbation we increased the carbon tax applicable to the non-tradable sector by €34 per tonne of carbon dioxide so as to generate €1 billion in carbon tax revenue in 2009 (Table 5). The approach taken here assumes that the tax is imposed unilaterally by Ireland and allowance has been made for the negative competitiveness effects of such a change. Details of how this negative competitiveness effect is implemented in the model are given in Conefrey, *et al.*, 2008.

The immediate effect of this shock would be to raise the price of energy for consumers and producers. The price of energy would rise by 5.3 per cent for consumers and by 19 per cent in manufacturing by 2015. The price rise for consumers is less due to the pre-existing excise taxes on motor fuels and the larger distribution margin. As a result consumer prices would rise by 0.2 per cent by 2015.

Table 5: Increase in carbon tax on non-tradable sector.

		2009	2010	2011	2012	2013	2014	2015
Percentage change relative to benchmark	%							
GDP	%	-0.1	-0.3	-0.4	-0.5	-0.5	-0.5	-0.5
GNP	%	0.1	0.0	-0.1	-0.1	-0.2	-0.1	-0.1
Consumption	%	-0.4	-0.4	-0.4	-0.5	-0.4	-0.4	-0.4
Average Non-Agricultural Earnings	%	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Consumption Deflator	%	0.4	0.3	0.3	0.3	0.3	0.2	0.2
Total Employment	%	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2
Labour Force	%	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1
Output Manufacturing	%	-0.1	-0.5	-0.7	-0.8	-0.9	-0.9	-0.9
Output Services	%	-0.1	-0.2	-0.3	-0.4	-0.3	-0.3	-0.3
Absolute change relative to the benchmark								
Unemployment rate, ILO Basis	Percentage Points	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Balance of Payments	% of GNP	0.6	0.5	0.5	0.5	0.4	0.4	0.4
General Government Balance	% of GDP	0.6	0.5	0.5	0.5	0.5	0.5	0.5
Borrowing Requirement	€million	871	820	813	835	923	996	1047
Carbon Tax Revenue	€million	1,000	983	981	989	1,010	1,039	1,070

Since workers bargain in terms of their real after-tax earnings, the rise in inflation would result in a rise in economy wide wage rates of 0.1 per cent. The manufacturing sector is a price taker on world markets. It cannot pass on domestic cost increases as increases in output prices. As a result Ireland would suffer a loss in competitiveness and some production would shift from Ireland to other locations. Because of the rise in domestic costs there would be a loss of competitiveness on world markets. The volume of gross output (and of value added) in manufacturing would fall by 0.9 per cent. In addition to manufacturing output, the rest of the industrial sector would also be affected. In particular, there would be a small reduction in the output of the building sector, additional to the more significant reduction in manufacturing output.

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[14] Here non-tradable refers to that part of the economy not covered by the EU Emissions Trading Scheme – electricity and a few industrial sub sectors such as the manufacture of cement.

Unlike manufacturing, the market services sector would pass through the rise in its costs as an increase in the price of its output, by 0.2 per cent. This increase in the price of services would have two effects. It would add to the impact on consumer prices (this additional impact is included in the estimated impact on consumer prices shown above). It would also raise the price of services exports so that the price deflator for exports of goods and services would rise by 0.2 per cent by 2015. This rise in the price of services exports would have an adverse impact on the volume of such exports. The volume of services exports would fall by 0.2 per cent below the baseline in 2015.

As a consequence of the fall in exports of services, and also because of the fall in the volume of consumption, there would be a fall in the volume of services output of 0.3 per cent by 2015. In turn, this would contribute to a fall in total employment of 0.2 percent by 2015.

Overall the fall in industrial and services output would cause GDP to fall by 0.5 per cent by 2015. GNP would be marginally higher as a result of the reduction in profit repatriations by the manufacturing sector and a reduction in government borrowing and accumulated foreign debt. While the lower level of economic activity would offset some of the increase in government revenue from the carbon tax, the government borrowing requirement would still be reduced by €871 million in 2009 or 0.6 per cent of GDP. By 2015 the reduction in borrowing would be around 0.5 per cent of GDP with GNP only lower by 0.1 per cent.

5.5 Lump Sum Tax on Households (Property Tax)

In this simulation we consider the impact of a property tax on households introduced from 2009. Figure 1 and Figure 2 show the impact of this policy change on output and the public finances respectively, the full simulation results are shown in Appendix 1. The shock is calibrated so that the immediate impact of the shock would be to raise €1 billion in additional tax revenue in 2009. The increase in taxation would reduce household disposable income and, as a result, consumption would fall by 1.3 per cent by 2015. Lower consumption would reduce the level of demand in the economy with the result that output in market services would fall by 0.4 per cent.

Figure 1: GDP and GNP, % change relative to baseline, property tax on households
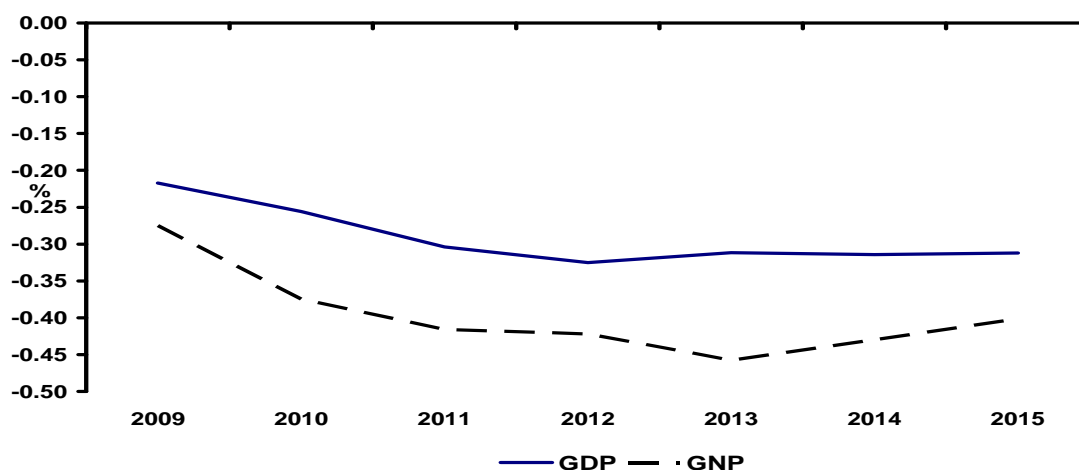
As a consequence of the fall in output, and also because of the fall in consumption, total employment would fall by 0.1 per cent and the unemployment rate would increase slightly by 0.1 percentage points.

Figure 2: General Government Balance as % of GDP, change relative to baseline, property tax on households
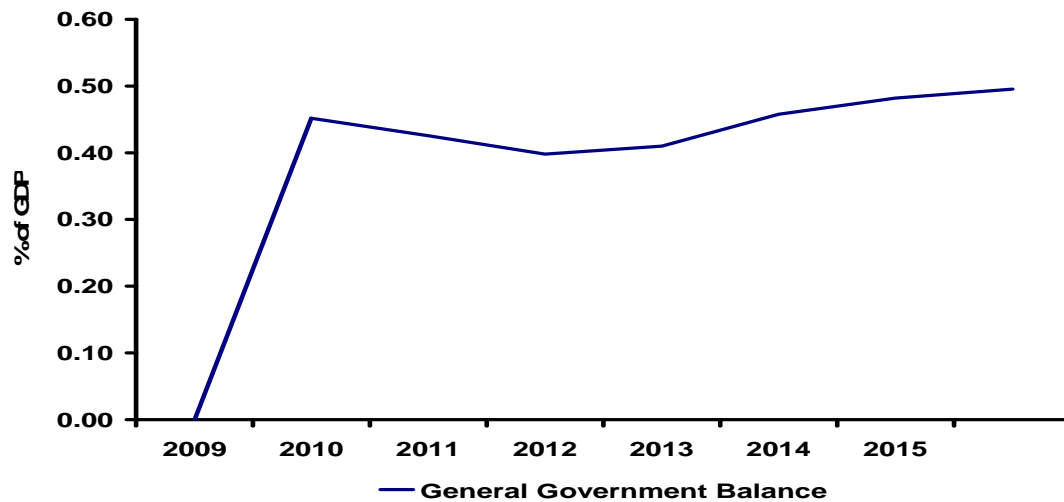
Overall the fall in industrial and services output would cause GNP to fall by 0.4 per cent and GDP to fall by 0.3 per cent by 2015. While the lower level of economic activity would offset some of the increase in government revenue from the property tax, the government borrowing requirement would still be reduced by €792 million in 2009 or 0.5 per cent of GDP (Figure 2). By 2015 the reduction in borrowing would be close to 0.5 per cent of GDP.

This simulation takes no account of a possible impact of a property tax on house prices and, through house prices, on the wider economy.

5.6 Reduction in Employment in Health and Education

In this simulation the numbers employed in health and education were reduced by around 18,000 from 2009. This reduction in the numbers at work in the sector would reduce the wage bill by €1 billion in 2009. The reduction in employment is assumed to be maintained at about 18,000 below the benchmark level until 2015. This shock would directly affect the volume of GNP and GDP by reducing public consumption by the amount of the fall in the public sector wage bill. This would reflect the loss of public welfare as a result of the major reduction in the level of public services. Of course, to the extent that the reduction in employment was achieved without a negative impact on services the reduction in GDP and GNP would be mitigated.

As shown in Table 7, the shock would have a significant impact on the volume of GNP and GDP, which would fall by 0.9 and 0.6 per cent respectively by 2015. The second round effects of this shock would arise from the reduction in purchasing power due to the reduction in the public sector pay bill. As a result the volume of consumption would fall by 1.1 per cent by 2015.

The reduction in health and education employment would affect the economy through a range of channels. Firstly the unemployment rate would initially rise by 1 percentage point. However, with extensive emigration it would eventually fall back to

0.3 percentage points by 2015. This effect on the labour supply would be uncertain because of the unusual international environment. In this simulation there is a reduction in the labour force of 0.5 per cent due to an increase in net emigration and reduced labour force participation. However, if the external environment were to continue to be very difficult such a level of emigration might not materialise resulting in higher unemployment in the medium term.

The reduction in wage rates of 0.6 per cent in 2015 as a result of the higher unemployment would improve industrial competitiveness, resulting in a gradual increase in the volume of industrial output and employment. By 2015 manufacturing output would rise to almost 0.3 per cent above the benchmark with employment in that sector 1 per cent higher. The increase in employment in the industrial sector would reflect the "crowding in" of the private sector and it would help offset some of the loss of employment elsewhere in the economy.

By 2015 the reduction in the government borrowing requirement arising from the cut in employment would amount to around €680 million, which corresponds to around two thirds of the saving in the public pay bill of €1.1 billion.

Table 7: 10% reduction in health and education employment, % change from benchmark

		2009	2010	2011	2012	2013	2014	2015
Percentage change relative to benchmark	%							
GDP	%	-0.8	-0.9	-0.9	-0.8	-0.7	-0.7	-0.6
GNP	%	-1.0	-1.3	-1.3	-1.2	-1.1	-1.0	-0.9
Consumption	%	-0.5	-1.0	-1.2	-1.3	-1.2	-1.2	-1.1
Average Non-Agricultural Earnings	%	0.0	-0.5	-0.7	-0.8	-0.8	-0.7	-0.6
Consumption Deflator	%	0.0	-0.1	-0.2	-0.2	-0.2	-0.1	-0.1
Total Employment	%	-1.1	-1.2	-1.1	-1.0	-0.9	-0.9	-0.8
Labour Force	%	0.0	-0.1	-0.3	-0.4	-0.4	-0.5	-0.5
Output Manufacturing	%	0.0	0.0	0.1	0.2	0.2	0.3	0.3
Output Services	%	-0.2	-0.4	-0.3	-0.3	-0.2	-0.2	-0.2
Absolute change relative to the benchmark								
Unemployment rate, ILO Basis	Percentage Points	1.0	0.9	0.7	0.5	0.4	0.4	0.3
Balance of Payments	% of GNP	0.0	0.1	0.3	0.3	0.3	0.3	0.3
General Government Balance	% of GDP	0.2	0.1	0.2	0.2	0.3	0.3	0.3
Borrowing Requirement	€million	483	437	420	445	567	636	676
Wage Bill, Health and Education	€million	-1,000	-971	-979	-991	-1,020	-1,049	-1,080

5.7 Reduction in Government Investment

In this simulation we consider the impact of a €1 billion reduction in expenditure on public investment under the National Development Plan. These results only take account of the demand side impact of the change in investment. They take no account of the longer-term supply side impact reducing national output and productivity as a result of the reduced stock of infrastructure. Previous research (FitzGerald and Morgenroth, 2006) has emphasised the importance of this omitted supply side channel on national output. Thus the longer-term impact of this cut on output and employment would be substantially greater than shown here.

Table 8 shows that the demand side impact of this shock has a relatively minor effect on output and employment in the economy in the short to medium term. The primary incidence of the shock is on the building sector where output, employment and investment all fall by over 2.8 per cent. The lower level of demand in the building sector leads to a small reduction in total employment and a rise in the unemployment rate of 0.1 percentage points. As a result there is a slight reduction of 0.2 per cent in wage rates by 2015.

In the medium term, the contraction of the building sector and the reduction in wage rates helps to crowd in other sectors of the economy and this helps to offset the direct loss to the economy from the reduction in government NDP expenditure. Employment in the services sector rises slightly which leads to a marginal increase in consumption by the end of the period. Overall, GNP and GDP are broadly unchanged as a result of the shock. The €1 billion cut in NDP expenditure has a big effect on the public finances with the exchequer borrowing requirement as a percentage of GDP falling by around 0.5 percentage points in the long run.

Table 8: Cut in Public Investment of €1 billion compared to benchmark

		2009	2010	2011	2012	2013	2014	2015
Percentage change relative to benchmark	%							
GDP	%	-0.3	-0.3	-0.2	-0.1	-0.1	-0.1	-0.1
GNP	%	-0.4	-0.4	-0.3	-0.2	-0.2	-0.2	-0.2
Consumption	%	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0
Average Non-Agricultural Earnings	%	0.0	-0.2	-0.3	-0.3	-0.3	-0.2	-0.2
Consumption Deflator	%	0.0	0.0	-0.1	-0.1	-0.1	-0.1	0.0
Total Employment	%	-0.4	-0.4	-0.3	-0.2	-0.2	-0.2	-0.2
Labour Force	%	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1
Output Manufacturing	%	-0.8	-0.7	-0.5	-0.3	-0.3	-0.3	-0.3
Output Services	%	-0.2	-0.2	-0.1	-0.1	0.0	0.0	0.0
Absolute change relative to the benchmark								
Unemployment rate, ILO Basis	Percentage Points	0.4	0.3	0.2	0.1	0.1	0.1	0.1
Balance of Payments	% of GNP	0.5	0.5	0.4	0.4	0.3	0.3	0.3
General Government Balance	% of GDP	0.4	0.4	0.4	0.3	0.4	0.4	0.5
Borrowing Requirement	€million	689	694	645	577	760	888	988
Expenditure on NDP	€million	-1,000	-889	-716	-544	-673	-726	-789

5.8 Standardised policy multipliers

Here we summarise the results set out in the previous sections where each of the policy variables are shocked so that their effect is to directly raise revenue or cut expenditure by €1000 million in the first year of the intervention. Figure 3 shows the impact on GDP of the *ex ante* change of €1000 million in each of the tax instruments. The results conform to theoretical expectations. To the extent that the incidence of the tax lies with households and is not passed on, the output effects are minimised. Where the tax change results in changes in behaviour, such as higher wage rates, the costs are increased. Generally an increase in income tax has quite a negative effect impact on output in the medium term. This is because wage bargaining takes place around real after tax wage rates so some of the incidence of the tax is passed forward to

employers as higher nominal wage rates. This would impact negatively on competitiveness, as well as reducing the purchasing power of the household sector. By adversely affecting the competitiveness of the manufacturing sector, a carbon tax would have a similar impact on GDP to a rise in income tax (though a lower impact on GNP). In terms of its impact on GDP, a property tax would have the least damaging effect on the economy because it does not affect wage competitiveness.

Figure 3: Standardised impact on GDP of changes in tax instruments of €1 billion
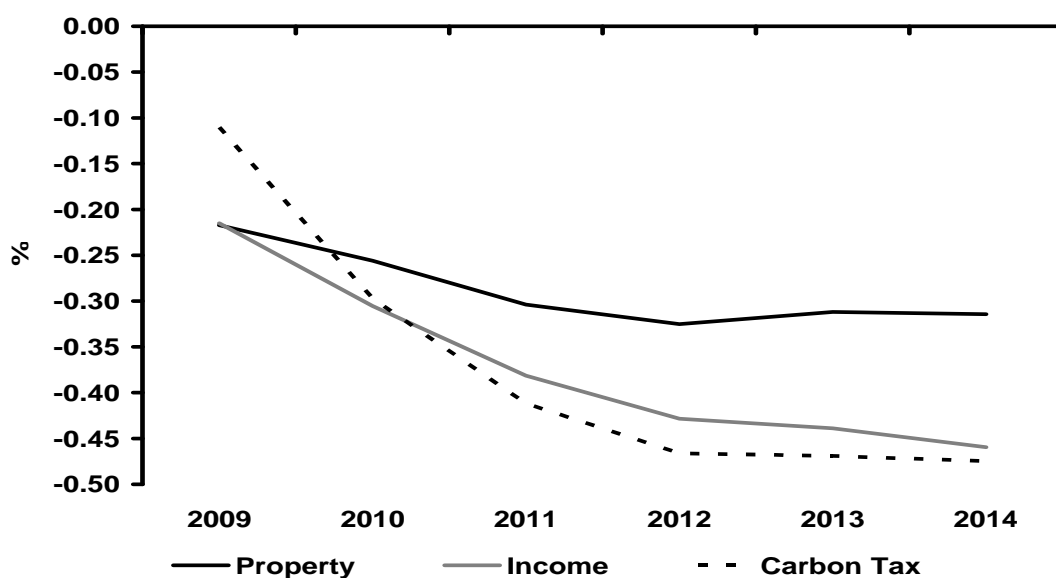

Figure 4 shows the impact on GDP of the *ex ante* change of €1000 million in each of the expenditure instruments. Cuts in public sector employment have the biggest negative impact on GDP and GDP both in the short term and the long term. This assumes that the cuts in employment result in a cut in public services. Obviously, to the extent that efficiency gains are made without impacting on public services the ultimate negative impact on welfare would be reduced. If the supply side impact of a cut in public investment is ignored, the short-term negative demand side impact is relatively limited.

Figure 4: Standardised impact on GDP of changes in expenditure instruments of €1 billion
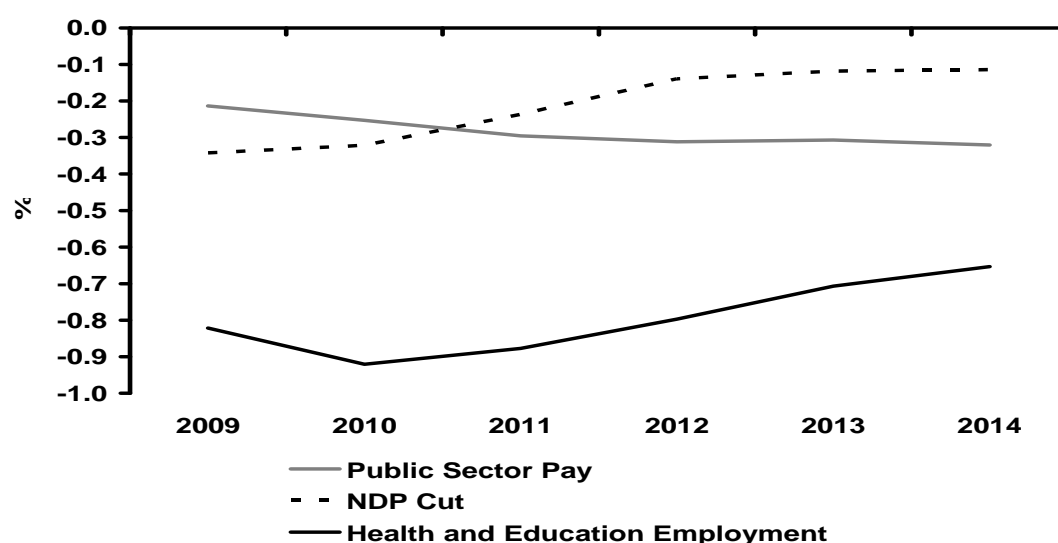
5.9 One per cent increase in world output

Given the openness of the Irish economy the domestic rate of growth is very dependent on developments in the outside world. Developments in the US probably have a greater significance than would be suggested by its weighting in trade. In this shock we simulate the effects of an increase in the world output of 1 percentage points from 2009. This shock illustrates how a recovery in world output would impact on the Irish economy.

Table 9: 1% increase in world growth, change relative to benchmark.

		2009	2010	2011	2012	2013	2014	2015
Percentage change relative to benchmark	%							
GDP	%	0.0	0.8	1.3	1.4	1.4	1.3	1.3
GNP	%	0.0	0.7	1.3	1.5	1.4	1.4	1.4
Consumption	%	0.0	0.1	0.6	1.1	1.4	1.5	1.5
Average Non-Agricultural Earnings	%	0.0	0.0	0.6	1.0	1.3	1.4	1.3
Consumption Deflator	%	0.0	0.0	0.1	0.2	0.3	0.3	0.3
Total Employment	%	0.0	0.4	0.6	0.6	0.5	0.4	0.4
Labour Force	%	0.0	0.0	0.0	0.1	0.2	0.3	0.4
Output Manufacturing	%	0.0	1.9	2.2	2.1	1.9	1.8	1.7
Output Services	%	0.0	0.4	1.2	1.4	1.4	1.3	1.3
Absolute change relative to the benchmark								
Unemployment rate, ILO Basis	Percentage Points	0.0	-0.3	-0.5	-0.4	-0.2	-0.1	0.0
Balance of Payments	% of GNP	0.0	0.4	0.5	0.5	0.3	0.3	0.3
General Government Balance	% of GDP	0.0	0.2	0.4	0.4	0.4	0.4	0.4
Borrowing Requirement	€million	0	270	441	534	619	682	751

The results of this shock are presented in Table 9 which shows the deviations of variables from their benchmark values. The shock to world output would increase the volume of net output (GDP arising) in the industrial and market services sectors in Ireland. With the bulk of output in the manufacturing sector being destined for export it is not surprising that the medium-term impact (in 2015) on the output of that sector would be 2%, double the shock to world output. While a growing share of market services sector output is exported, the bulk of the output still goes to satisfy domestic demand. Thus the impact on the output of the market services sector would be less than that for manufacturing at +1.3 per cent

The overall rise in employment arising from the shock to world output would be less than the increase in output. Total employment would be up by 0.6 per cent in 2012 while the unemployment rate would fall by 0.4 percentage points. As a result of the tightening in the labour market wage rates would end up around 1.3 per cent higher than in the base. This would have some offsetting effect on Irish output and employment through reducing Irish competitiveness. However, if a similar rise took place in prices and wages outside Ireland this negative offset would not occur and the long run effects on output and employment would remain around the level shown for 2012.

It is assumed that there is no change in fiscal policy other than through indexation. The increase in output and employment in the economy would increase government revenue from a range of taxes while the fall in the unemployment rate would reduce government welfare payments. The net effect on the public finances would be a substantial reduction in the government borrowing requirement as a percentage of GDP of 0.4 percentage points by 2015.

There would also be a significant positive impact on the balance of payments current account (a 0.3 percentage points reduction in the deficit or increase in the surplus) as a result of the foreign stimulus. While such an improvement in the balance of payments could endure for quite a number of years, in the long term it would result in higher domestic consumption. If this long-term wealth effect on consumption were taken into account, so that the balance of payments was unchanged, then the positive impact on growth and the public finances would be enhanced.

Consumer prices would increase by 0.3 per cent as a result of higher wage rates in the economy. This would act as only a partial offset to the rise in wage rates so that real personal disposable income would be substantially increased. This would sustain an increase in consumption of 1.5 per cent compared to the base in 2015.

Overall GDP in Ireland would be increased by 1.3 percentage points in 2015 as a result of this shock to world output.

5.10 Competitiveness improved by one per cent through higher foreign prices and wages

In this exercise we simulate an improvement in Irish competitiveness by increasing wage rates and prices in Ireland's main competitor economies, including the US, the UK and the EU, by 1 percentage point compared to the benchmark. This can be seen as replicating a change in the external value of the currency. The effects shown in this simulation differ from those shown earlier for a cut in wage rates in that external prices also change. Changing external prices affect the economy in two ways. Firstly, the rise in the output price of manufacturing firms as a result of the rise in foreign

prices in Ireland increases their profitability by more than a similar reduction in wage rates (Irish manufacturing is a price taker on the world market). Secondly, it affects the relative returns to working in Ireland and abroad and, hence, it affects labour supply through migration.

It is through the output of the industrial and market services sectors that the improvement in competitiveness affects the Irish economy. Irish manufacturing firms export over 80 per cent of their output and are price takers in international markets. As shown in this simulation (Table 10), Irish manufacturing output shows a supply elasticity of unity when faced with a one percentage point improvement in competitiveness. The market services sector still produces the majority of its output for the domestic market and thus shows less responsiveness to an improvement in Irish competitiveness. Net output (GDP arising) in services would increase by 0.6 per cent in 2015 as a result of the shock.

The increase in output in both industry and services would lead to an increase in total employment of 0.3 per cent and a reduction in the unemployment rate of 0.2 percentage points. As a result, Irish wage rates would be around 0.3 per cent above base by 2015.

The reduction in the unemployment rate in Ireland would make Ireland more attractive for immigrants so there would be a slight increase in the labour force of 0.1 per cent. Higher levels of economic activity and employment would increase government revenue from taxation with the result that the government borrowing requirement as a percentage of GDP would fall by almost 0.4 percentage points. Overall GNP would increase by 0.2 per cent in volume terms by 2015 while GDP would be up by around 0.6 per cent. Higher exports would lead to an improvement in the balance of payments of close to 0.5 percentage points while consumer prices would increase slightly by 0.1 per cent. As in the case of the previous shock the improvement in the balance of payments would hold out the prospect of additional benefits in the longer term.

Table 10: 1% improvement in Irish competitiveness, change relative to benchmark.

		2009	2010	2011	2012	2013	2014	2015
Percentage change relative to benchmark	%							
GDP	%	0.1	0.3	0.4	0.5	0.6	0.6	0.6
GNP	%	-0.1	0.1	0.1	0.2	0.2	0.2	0.2
Consumption	%	0.1	0.1	0.1	0.2	0.3	0.3	0.4
Average Non-Agricultural Earnings	%	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Consumption Deflator	%	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total Employment	%	0.1	0.2	0.2	0.3	0.3	0.3	0.3
Labour Force	%	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Output Manufacturing	%	0.2	0.6	0.8	0.8	0.9	0.9	0.8
Output Services	%	0.1	0.3	0.4	0.5	0.6	0.6	0.6
Absolute change relative to the benchmark								
Unemployment rate, ILO Basis	Percentage Points	0.0	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2
Balance of Payments	% of GNP	0.1	0.4	0.4	0.5	0.4	0.4	0.5
General Government Balance	% of GDP	0.1	0.3	0.3	0.3	0.4	0.4	0.4
Borrowing Requirement	€million	110	273	389	472	599	695	777

6. Conclusions

In this paper we have used the HERMES model to explore how the Irish economy would react to changes in key variables, most particularly to changes in policy variables. These results are valid for the current environment that the Irish economy faces. However, the values could be rather different if that environment were to change significantly. Thus these multipliers or shocks need to be rerun if there is any major change in the general economic environment.

These results can be of use in developing policy measures, allowing an assessment to be made of their wider economic impact. In general, as shown in these simulations, the *ex ante* change in government expenditure or revenue from a given policy instrument is greater than the eventual impact on the borrowing requirement. This is due to the indirect impact of policy instruments on government revenue and expenditure under other headings. The extent to which revenue is lost or expenditure rises as a consequence of a policy change aimed at cutting borrowing varies significantly depending on the instrument actually used.

The fact that the model does not explicitly handle how households' expectations are formed and how they affect consumption and household investment means that it may not fully capture the short-term response of households to fiscal policy. For example, if households expect the government to tighten fiscal policy in the future they may react by increasing savings in the expectation of future tax increases. Thus it is possible that the deflationary impact of a rise in taxes this year may already have been partly discounted by households as reflected in the dramatic increase in the savings rate. This factor must be taken into account when interpreting the results shown here.

The simulations suggest that when the government takes fiscal policy measures to reduce the borrowing requirement they will have a counterpart in the form of a change in the balance of payments of at least a similar magnitude. Thus a major tightening of fiscal policy this year would be likely to substantially reduce the balance of payments deficit (or increase the surplus).

The impact of the different policy measures on unemployment in the short term must be considered particularly uncertain because of uncertainty about the pattern of migration in the immediate future. We have not experienced an occasion in the past when all world labour markets simultaneously faced rapidly rising unemployment. What this means is that where an increase in emigration (reduction in immigration) is expected to occur because of a change in fiscal policy the reality may be different and unemployment may, as a consequence, rise by more than expected in the short term.

These simulations do not take account of the significant positive supply side effects from public investment.

As outlined earlier, the model does not fully take account of changes in perceptions about the Irish economy arising from concerted policy changes. For example, a budget that was seen to restore the economy to a sustainable growth path could enhance confidence. In turn this could lead to a reduced risk premium on borrowing and a reduction in the personal savings rate. These effects could be very important.

These simulations can also help us understand the effects of major changes in key exogenous variables such as world growth. However, when a number of different important variables or policy parameters change simultaneously it is important to

undertake a full model run to take account of interaction effects between the simultaneous changes in many variables or instruments.

Finally, while competitiveness, both measured in terms of labour costs and a much broader definition, is not a policy lever available to governments, the simulations shown here illustrate how it impacts on output, employment, and the public finances in the longer term.

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Appendix 1

Table A1: Property tax on households from 2009, % Change relative to baseline

		2009	2010	2011	2012	2013	2014	2015
Percentage change relative to benchmark	%							
GDP	%	-0.2	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
GNP	%	-0.3	-0.4	-0.4	-0.4	-0.5	-0.4	-0.4
Consumption	%	-0.9	-1.0	-1.1	-1.2	-1.2	-1.3	-1.3
Average Non-Agricultural Earnings	%	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1
Consumption Deflator	%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Employment	%	-0.1	-0.1	-0.1	-0.2	-0.1	-0.1	-0.1
Labour Force	%	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
Output Manufacturing	%	0.0	-0.1	-0.1	-0.1	-0.1	0.0	0.0
Output Services	%	-0.3	-0.4	-0.4	-0.5	-0.4	-0.4	-0.4
Absolute change relative to the benchmark								
Unemployment rate, ILO Basis	Percentage Points	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Balance of Payments	% of GNP	0.3	0.4	0.5	0.5	0.5	0.5	0.5
General Government Balance	% of GDP	0.5	0.4	0.4	0.4	0.5	0.5	0.5
Borrowing Requirement	€million	792	735	712	748	879	987	1080
Property Tax Revenue	€million	1,000	975	999	1,051	1,118	1,202	1,293