IMF STAFF DISCUSSION NOTE

Wage Moderation in Crises

Policy Considerations and Applications to the Euro Area

Jörg Decressin, Raphael Espinoza, Ioannis Halikias, Daniel Leigh, Prakash Loungani, Paulo Medas, Susanna Mursula, Martin Schindler, Antonio Spilimbergo, and TengTeng Xu

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Authorized for distribution by Maurice Obstfeld and Poul M. Thomsen

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EXECUTIVE SUMMARY

This paper discusses the short-run economic impact of wage moderation and the implications for policy in the context of the euro area crisis, with a focus on the roles of monetary policy and the zero lower bound (ZLB). It explores the channels through which wage moderation affects output, presenting a coherent, multi-country model for the euro area.

In an economy hit by a sudden stop of private capital flows, the current account deficit typically contracts, as domestic credit for consumption or investment slows sharply in response to the drop in foreign funding. The task of returning to full employment within a tighter external financing constraint requires both higher domestic and foreign demand. In this context, IMF staff advice usually stresses the benefits of lower interest rates and exchange rate depreciation to boost demand and competitiveness. But for countries in a currency union, such as the euro area, exchange rate depreciation is not available. Instead, lower nominal wage growth—wage moderation—and lower inflation or higher productivity growth relative to trading partners is needed. More generally, the measures aimed at changing the relative prices to regain competiveness when the nominal exchange rate is fixed are often referred to as "internal devaluation." While internal devaluation could include labor, product, and fiscal measures, this paper focuses solely on labor.

Nominal wage growth has moderated sharply, but wages have not fallen relative to precrisis levels in most euro area crisis-hit economies. More wage moderation is necessary in these economies over the medium run to increase employment, while avoiding a return of large current account deficits. This paper establishes that wage moderation in the crisis-hit economies increases their output but monetary policy has a crucial role to play in mitigating the appreciable negative spillovers of this moderation on other euro area economies. It also quantifies the potential output benefits of implementing the G20 structural reforms that euro area countries committed to recently.

The analysis focuses on the short-run domestic impact and external spillovers of wage moderation. Specifically, we focus on lower wage and price inflation as a means to rebuild competitiveness and thus on something akin to an incomes policy. By contrast, IMF advice in euro area program countries has emphasized structural labor market reforms, with a view to lowering natural unemployment or raising labor force participation. What has not been part of any program: an explicit incomes policy to engineer an internal devaluation. The incomes policy we consider for simulation purposes is a coordinated, exogenous 2 percent reduction in wage (and price) inflation. Such wage moderation, if pursued by a single country, boosts external competitiveness and exports, but its overall effect on output in the short run is subject to debate. The reason for this outcome: lower nominal wage growth and lower inflation, or possibly deflation, can suppress domestic demand and increase the real burden of debt. Concerning output, these effects work in the opposite direction of the competitiveness effect. Which effects prevail in the short run? This paper explores this open question using the IMF's Flexible System of Global Models.

The model simulations suggest that the sign and size of the effect of wage moderation on output in the short run depend on several conditions, notably the number of economies pursuing it at the

same time, and the conduct of monetary policy. If a single euro area crisis-hit economy undertakes wage moderation, the net effect on output is positive both for that economy as well as for the entire euro area. If all crisis-hit economies (which account for some 30 percent of the euro area total GDP) undertake wage moderation together, their output still expands in the short run, albeit to a lesser degree. If monetary policy is unconstrained by the ZLB on interest rate, as in the precrisis period, output also expands in the entire euro area. However, when the ZLB binds, the negative spillover effect of wage moderation in the crisis-hit economies on output in the other economies cannot be offset by a cut in interest rates. Unless other actions are taken to lower agents' funding costs, euro area-wide output contracts in the short run.

IMF staff advice has underscored the benefits of supportive monetary policies and growth-enhancing structural reforms. The analysis confirms that if monetary policy gets around the ZLB by responding with quantitative easing—simulated with a 50 basis point reduction in the aggregate term premium—output in the crisis-hit economies as well as the euro area as a whole rises modestly in the short run in response to wage moderation. If, additionally, the European Union economies implement the structural reforms that they committed to undertake within the G20 initiative launched by Australia in 2014, output increases further.

I. INTRODUCTION

1.   **Early in the crisis, several euro area deficit economies, including Greece, Ireland, Portugal, and Spain, experienced a "sudden stop" of private capital flows.** Banks from the core economies—such as Germany, France, and the Netherlands—and other investors withdrew their funds from the deficit economies and liquidity dried up.[1] In the short run, faced with a tighter external funding constraint, the deficit countries needed external public support to help their private sectors pay their bills or face financial collapse. The European Central Bank stepped in where core banks and investors had left but could only lend against good collateral. The European Financial Stability Facility, European Stability Mechanism, and IMF followed with uncollateralized lending. All this lending, sadly, could not forestall exceptionally deep recessions.

2.   **The sudden stop resulted in a sharp compression in these economies' current account deficits, and a surge in unemployment.** To minimize the social and economic costs of adjustment following a sudden stop, IMF staff advice typically stresses the benefits of exchange rate depreciation. This approach reduces not only real wages but also real interest rates. However, such action is possible only in countries with their own currency. In a currency union, such as the euro area, a period of lower (productivity-adjusted) wage and price growth relative to trading partners is typically necessary to rebuild competitiveness. Because interest rates are a function of area-wide conditions, they may not fall in real terms by as much as that of a single economy experiencing currency depreciation. The same holds for the real value of debts.

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[1] See Merler and Pisani-Ferry (2012) for a discussion of the timing and triggers of the private capital flow reversals faced by the crisis-hit economies of the euro area, which they qualify as "sudden stops."

3.   **The process of wage moderation is now in train, to varying degrees, in the crisis-hit economies, with wages declining relative to productivity**. However, additional relative price adjustment is needed to avoid the reemergence of unsustainable external deficits in these economies during the recovery of growth and employment (see Decressin and others, 2014). Alternatively, these economies need to implement structural reforms to boost their productivity relative to their trading partners but these actions take time.

4.   **Wage moderation, if pursued by a single country, improves external competitiveness and raises exports. Its effects on output, however, are subject to debate—particularly when it is pursued concurrently in other countries or when monetary policy is constrained by the zero lower bound (ZLB) on interest rates.** The reason for such debate is that lower nominal wage growth and lower inflation, or possibly deflation, can suppress domestic demand and increase the real burden of debt. These effects could offset the beneficial effects of the depreciation on exports. Which effect prevails in the short run? This is an open question, on which relatively little work has been done. Bean (1998), for example, shows that a reduction in wages can be contractionary in the short run if it is not undertaken in conjunction with expansive macroeconomic policies. Moreover, wage moderation may have negative spillovers on partner economies. With respect to the supply side, wage moderation will boost employment as the price of labor cheapens relative to that of capital. However, this effect will be felt mainly when countries' output gaps are closing, in the medium run. A paper very similar in spirit, Charpe and Kühn (2015), shows in a two-country Dynamic Stochastic General Equilibrium (DSGE) model that the effect of wage moderation on the domestic economy is positive but its international spillovers are ambiguous, depending on a range of parameters. The authors also show that domestic effects and spillovers are negative when the ZLB is binding.

5.   **This paper discusses the factors that determine the impact of wage moderation on output in the short run, and the implications for policy in the context of the euro area.** It uses the crisis-hit economies of the euro area as an example, and explores the channels associated with wage moderation in a coherent multi-country framework—the IMF's Flexible System of Global Models (FSGM). In particular, it discusses the roles of monetary as well as structural policies, in shaping the impact of wage moderation on output in the short run, including its spillovers on other economies. The broader question of how structural changes in wage setting institutions and practices—including the impact or labor reforms currently in train in several countries—affect output and employment is beyond the scope of this paper but is tackled comprehensively in *Jobs and Growth: Supporting the European Recovery* (Schindler and others, 2014).[2] The paper begins (Section II.A) with some background on the challenge of wage adjustment in a currency area. It also outlines the theoretical channels through which wage moderation influences economic activity in the short run. It then (Section II.B) quantifies the importance of these channels using model simulations of wage moderation scenarios for crisis-hit euro area economies, conducted using the

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[2] The authors argue that simultaneous product and labor market reforms will maximize the impact on potential growth, in part by allowing better integration of European countries into global supply chains. In the realm of labor reforms, the authors single out the need for many countries to reduce labor market dualism (a large share of employees in temporary contracts with low employment protection).

IMF's FSGM. Section III concludes with a discussion of the policy conclusions that emerge from the analysis.

II.   WAGE ADJUSTMENT IN THE SHORT RUN

6.   **Wage adjustment is challenging in a currency area**. History tells us that real wage adjustment happens in two ways: depreciation of the currency or inflation. In countries with competitiveness problems (and attendant external imbalances), the exchange rate eventually depreciates or is devalued. This lowers the real consumption wage and thereby reduces demand for foreign goods.[3] In turn, depreciation with sticky nominal wages reduces real wages. This mechanism is not available for the former high external deficit economies in the euro area because they operate in a currency union.

7.   **The question of how the adjustment can best be achieved thus remains of high importance**. In a country within a currency union with an initial, excessively large current deficit when output is at potential, wages and prices must adjust. This can be done by waiting for unemployment to do the job, or by having wage moderation. How to get wage moderation? Many institutional features determine the responsiveness of private wages to unemployment. Specifically, the wage level in the private sector depends on the features of collective wage bargaining, the existence (and level) of minimum wages, public sector wages, duality in labor markets and the level of employment protection, entitlement systems (unemployment benefits, social assistance, and disability and early retirement schemes, for example), and, importantly, on the trust between the social partners. Reforms or changes on any of these fronts can deliver wage moderation. We focus on the potential role of an incomes policy: a deliberate, across-the-board slowdown in wages and prices. Such an internal devaluation has not been tried in any of the crisis economies.

8.   **Notice, however, that a devaluation and an incomes policy are not strictly or practically full substitutes, even abstracting from their opposite effects on inflation and real interest rates**.[4] Devaluation affects not just real wages, but also returns to other factors (such as rents and profits, etc.). In practice, a devaluation will also affect all workers equally in the short run, while an incomes policy may only govern certain workers (for example, in industry and large firms, but not SMEs entrepreneurs, service sector employees). So, the burden of adjustment will be shared differently in wage adjustment versus exchange rate devaluation scenarios.

9.   **We now lay out the channels through which wage moderation—smaller nominal wage and price increases or nominal wage and price reductions—affect both external and internal demand in the short run, and highlight how the overall effect depends on different assumptions.** The focus is on the effects of wage moderation induced by deliberate measures, such

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[3] Real product wages fall if domestic firms do not pass on the entire drop in wages onto domestic prices. With a constant markup they stay unchanged (this is discussed further in paragraph 12).

[4] Our mechanism requires that both devaluation and incomes policy affect inflation expectations rather than just have a one-off effect on the price level.

as an incomes policy, rather than as an endogenous reflection of depressed economic activity.[5] When we quantify the channels at work and the potential role for macroeconomic policies with simulations that use the IMF's FSGM, we assume that wages and prices slow in tandem, thereby mimicking the effect of an internal devaluation.

A. Channels

10.   **This subsection lays out the main channels through which wage moderation affects economic activity in the short run**. The discussion is based on standard macroeconomic models in which aggregate demand depends, in the short term, on real exchange rates, real interest rates, and fiscal policies. We also discuss the role of public and private debt and the distribution of income across firms and workers in determining the effects of wage moderation.

External competitiveness

11.   **Wage moderation enhances external competitiveness, with the benefit depending critically on the number of economies pursuing wage moderation simultaneously.** Wage moderation increases exports by contributing to a decline in domestic prices relative to trading partners' prices. In the absence of nominal exchange rate adjustments at the country level, such a relative price decline implies a real exchange rate depreciation and a rise in exports. It is worth recalling, however, that not all economies can reduce domestic prices relative to all other economies at the same time. Therefore, wage moderation improves a country's external competitiveness most when not pursued simultaneously with other economies. Furthermore, the extent to which wage moderation improves competitiveness depends on the extent to which lower wages translate into lower prices.

12.   **Firms' costs (and prices) depend on wages.** In standard New Keynesian models in which monopolistically competitive firms set their prices as a markup over marginal costs (see Galí, 2008, for example), lower wages translate into lower prices.

- With a constant markup, nominal wages do not fall relative to the prices of domestic goods but do fall relative to the prices of imported goods—real consumption wages decline, while real product wages stay constant. There is thus no redistribution of income from labor to capital. The drop in nominal labor income and profits can lead to an increase in households' and firms' real interest rates and debt burden, which detracts from domestic demand.

- When firms raise the markup, then nominal wages also fall relative to the prices of domestic goods—real product wages fall. There is redistribution of income from labor to capital and this can affect demand. Real debt burdens rise and reduce domestic demand but less so than in the scenario with a constant markup. During the crisis, pass-through from wages to domestic prices has indeed been less than one.

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[5] These measures could include, for example, those associated with incomes policies and adjustments in public sector wages.

- Another issue involves firms' pricing in foreign markets: if this practice remains unchanged, foreign demand will not increase. However, the improvement in profits of exporters should eventually lead to an increase in investment and supply of tradable goods.

Real interest rates

13. **Wage moderation may increase real interest rates by reducing inflation**. Wage moderation can reduce domestic inflation, and, if nominal interest rates do not adjust commensurately, imply higher real interest rates, and lower consumption and investment. This channel is relevant for euro area economies today, since monetary policy is constrained by the ZLB on nominal interest rates and there is no monetary policy response at the country level (see Galí, 2012 and Galí and Monacelli, 2013, for a discussion).[6][7] By contrast, with unconstrained monetary policy, the standard response of the central bank to a fall in inflation would be to reduce the policy interest rate to stimulate aggregate demand until inflation again looks set to hit the policy target over the medium run. The reduced interest rate in this case would also reduce the value of the domestic currency, further supporting the competitiveness effect already mentioned. Overall, this channel highlights the importance of the monetary policy response in shaping the macroeconomic effects of wage moderation.

Real debt burden

14. **A reduction in domestic prices can increase government and private debt in real terms and as a ratio to GDP**. This could prompt tighter fiscal policy in countries committed to a government debt reduction plan. A large literature suggests that governments do tend to take corrective measures in response to an increase in government debt (see Bohn, 1998, and others). Tax hikes or spending cuts associated with such corrective action are likely to reduce output in the short term (see IMF, 2010). Wage moderation can also increase the real burden of household debt and, beyond inducing a moderation of consumption of imported goods, also lead to less consumption of domestic goods, if their prices do not fall one-for-one with wages (see Eggertsson and Krugman, 2012). Relatedly, for households who consume all their income and do not have ready access to credit, wage moderation implies the need to reduce consumption growth. A similar effect is also relevant for corporate debt. This channel highlights the importance of monetary policy––because of its effect on inflation and thus real debt––and fiscal policy in determining the effects of wage moderation.

Income distribution effects

15. **Wage moderation could increase income inequality**. If wage moderation does not fully pass through to lower domestic prices, real product wages fall and profits rise, implying a shift in the

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[6] A pre-announced strategy of wage moderation is likely to be particularly relevant for future expected inflation and, therefore, for real interest rates. An unexpected one-time cut in nominal wages could, in principle, have no implication for future inflation, although this is unlikely given widespread evidence of inflation persistence.

[7] That said, long-term, risk-free interest rates remain above zero in all euro area economies, and even short-term rates are being kept above zero in many economies by large risk premiums. This situation opens other policy avenues to counter deflationary pressure.

distribution of income from workers toward capital owners. Inequality may also increase if the lever to restrain wage growth is limits on the minimum wage, although if the minimum wage is too high it can increase inequality through higher unemployment. The overall effect of this shift on aggregate demand is uncertain. On the one hand, a shift in the distribution of income from labor to capital implies, other things equal, a reduction in consumption, particularly among lower-income or credit-constrained workers who are likely to have a high marginal propensity to consume. On the other hand, the rise in profitability is likely to spur private investment, particularly if firms are credit constrained and therefore depend on internal cash flow. The overall effect on aggregate demand of the shift in income distribution could therefore go either way, depending on the relative marginal propensities to spend of households and firms.[8]

B.   Illustrative Model Simulations

16.   **To illustrate these various channels, this sub-section reports the results of model simulations of wage moderation scenarios for the euro area crisis-hit economies conducted using EUROMOD, a module of the IMF's FSGM.** EUROMOD is an annual, multi-economy, forward-looking, model of the global economy combining both micro-founded and reduced-form formulations of economic sectors. EUROMOD contains individual blocks for 11 euro area economies.[9] It includes the five economies—Greece, Ireland, Italy, Portugal, and Spain—which to quite varying degrees were hit harder by the euro area crisis than their euro area partners. These are henceforth called "crisis-hit economies" for the purposes of this paper. It should be noted, however, that Italy—which had smaller current account deficits and a stronger net international investment position than the others —did not need financial support either from its euro area partner countries or international institutions and that all the other crisis-hit economies except Greece have in the meantime exited their external support programs. Moreover, these economies are not modeled in any way as being in a crisis; rather, they are seen to face, again to varying degrees, a greater need to bring down unemployment and rebuild competiveness via wage moderation than most of their partners. The following are key features of the EUROMOD country models (see Appendix):

- Consumption and investment have microeconomic foundations. Specifically, consumption features overlapping generations model (OLG)-type households and liquidity-constrained households. Households are net lenders.[10] Households are otherwise not heterogeneous, which means that we cannot discuss the effects of wage moderation on inequality and, via inequality, on the economy.

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[8] Our model assumes similar marginal propensities to consume across agents and hence domestic demand falls less in the case where firms raise the mark-up, as noted earlier. Kumhof, Ranciere, and Winant (forthcoming) highlight an additional distributional channel not considered here: the rise in profitability, instead of spurring private investment, could spur increased lending from capital owners to workers, which increases financial fragility.

[9] The semi-structural nature of FSGM, as well as its dynamic properties, are similar to models used at other policy institutions, such as the FRB/U.S. model of the Federal Reserve (see Brayton and Tinsley, 1996) and the Bank of Canada's GMUSE model (see Blagrave, Godbout, and Lalonde, forthcoming).

[10] Notice that with this model we cannot consider the effects of change in the income distribution on output.

- Firms' investment is determined by a Tobin's q model. Firms are net borrowers and their risk premiums rise during periods of excess capacity, when the output gap is negative, and fall during booms, when the output gap is positive. This trend mimics, for example, the effect of falling/rising real debt burdens.

- Trade is pinned down by reduced-form equations as a function of a competitiveness indicator and domestic and foreign demand. The competitiveness indicator improves one-for-one with domestic prices—there is no local-market pricing.

- Potential output is endogenous, modeled by a Cobb-Douglas function with exogenous productivity but endogenous capital and labor supply.

- Inflation in prices and wages are modeled by Phillips curve.

- The model features standard monetary and fiscal policy reaction functions. But we do not allow for endogenous quantitative easing (QE). The government is another net borrower. Its funding costs are pinned down by the policy rate and the long-term interest rate.

- Each economy in the model is structurally identical, but with different key steady-state ratios and different behavioral parameters.[11] The model is essentially linear, with one critical exception: in the baseline simulations, it is assumed that the ZLB is binding—this assumption essentially captures the depressed state of aggregate demand in the euro area.

Assumptions

17.   **We start by discussing a hypothetical scenario in which we assume that a single euro area crisis-hit economy pursues wage moderation alone.** We then investigate how the results change when a number of economies pursue wage moderation at the same time. Finally, we report the results of additional simulations that provide additional insights on the various channels at work, and how the results depend on key policies and assumptions. Before reporting the simulation results, we review the main assumptions underlying the simulations.

18.   **To focus on the short-term effects of wage moderation, we assume that it occurs through an exogenous reduction in nominal wage growth by 2 percentage points over two years which, in the main simulations, is fully passed on to prices (constant mark up).** To induce wage moderation in the model, we add a negative "cost-push" shock to the equation determining wage inflation in each economy (wage Phillips curve).[12] In particular, we assume that the reduction in

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[11] See Andrle and others (2014) for details of the model's structure and how its parameters are calibrated or estimated.

[12] Wage inflation is defined by a wage Phillips curve, which has the following form:

$$\pi_t^w = c_1^w E_t \pi_{t+1}^w + (1 - c_1^w) \pi_{t-1}^w - c_2^w \log((1 - \alpha)/(1 - \alpha^{FE})) + c_3^w \log(Output\ Gap_t) + \varepsilon_t^{\pi w}$$

in which wage inflation, π_t^w, is defined by its own expected value and lag as well as the gap between the current and steady-state labor share of income, $\log((1 - \alpha)/(1 - \alpha^{FE}))$, and the output gap (defined as the log of the ratio of output to full-employment output). The parameter values, c_1^w, c_2^w, and c_3^w are chosen using a combination of empirical

wage inflation occurs in two stages: by 1 percentage point in the first year, and by an additional 1 percentage point in the second year. Thereafter, the growth rate of nominal wages returns gradually toward the baseline, implying a permanent decline in the nominal wage level relative to baseline. Clearly the required adjustments to wages were much larger than 2 percent at the beginning of the crisis. But increasing the amount of wage adjustment does not change the qualitative results.[13]

19.   **This approach to modeling wage moderation brings out some key short-run macroeconomic dynamics in a clear way but warrants some caveats.** The shock to wages can be thought of as an accelerated reduction in real consumption wages relative to a baseline path that already features wage moderation relative to productivity—real product wages stay constant in the main simulations, as prices move in tandem with wages. This accelerated reduction in wages and prices could, for example, be the objective of a social pact that aims to bring forward the required adjustment in competitiveness in a crisis-hit economy, with no long-term deviation from baseline in the real exchange rate. Such a pact, it must be said, has not featured in the crisis-hit economies. Accordingly, the moderation does not come in response to a permanent or temporary expansion in the supply of labor that raises actual and potential output—for simulations along those lines see Dao (2013) and Charpe and Kühn (2015).[14] Its effect is thus different from that of a structural reform that raises labor supply, although in practice such reforms have been found to have only small positive effects on output in the short run when there is excess capacity (Bordon, Ebeke, and Shirono, 2015). Furthermore, it is assumed that the shock to wages does not alter production technology, namely the mix of capital and labor, in the short run. Adjustments may occur in practice but mainly over the medium run, as economies' output gaps close. The best way to think about the moderation is as an internal devaluation via a coordinated reduction in wages and prices. It is not wage moderation aimed at reducing structural unemployment, which would require structural reforms such as those that have featured in programs of crisis-hit economies.

20.   **Other assumptions include**:

- **Firms pass the lower wages fully into lower domestic prices**: as mentioned above, the markup of prices on wages is fixed. This is in line with standard New Keynesian models in which monopolistically competitive firms set their prices as a markup over labor costs (see Galí, 2012,

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estimation and calibration in accordance with the literature, as described by Andrle and others (2014). Importantly, expected wage inflation $E_t \pi_{t+1}{}^w$, consists of both the model-consistent future value and an exogenous shock: $E_t \pi_{t+1}{}^w = \pi_{t+1}{}^w + \varepsilon_t{}^{\pi w}$. In the simulations, we apply a negative shock to this wage expectations term that is sufficient to reduce actual wage inflation by 1 percentage point relative to baseline in the first year, and by 2 percentage points in the second year.

[13] At some stage, however, the amount of wage moderation could become so large that it may not be possible to offset its negative effect on inflation and domestic demand with monetary policy, if short and long-term interest rates are not sufficiently high.

[14] Potential output only changes indirectly, in response to changes in investment.

for example).[15] Thus, real product wages are fixed and there is no redistribution from labor to capital. We briefly explore a scenario with a rising markup.

- **No independent monetary policy at the country level among euro area members, and the policy rate is constrained by the ZLB.** This is an important feature of many advanced economies today. To explore how wage moderation would differ in settings where monetary policy is less constrained, as in more normal times, we also report results based on the assumption that monetary policy eases via QE that reduces the term premium on long-term interest rates by 50 basis points.

- **Governments tighten fiscal policy in response to an increase in government debt**. There is evidence that, following the onset of the crisis, euro area crisis-hit economies' fiscal balances responded much more strongly to increases in government debt and much less to cyclical developments than in previous years (see Baldi and Staehr, 2013, for statistical evidence of such a shift). In line with this evidence, we assume no operation of automatic stabilizers (no response of the fiscal balance to output), and that the fiscal balance rises by 0.2 percentage point of GDP for every percentage point rise in government debt.[16,17] This approach ensures that the government debt-to-GDP ratio returns to baseline over the medium term. Government spending (on general transfers) is the instrument that adjusts to achieve this fiscal outcome.[18]

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[15] Given that firms could plausibly pass less than the full reduction in labor costs implying higher profits and a smaller labor income share—pass-through has indeed been below one for a number of economies during the crisis as already mentioned—we also briefly discuss the results for a 50 percent pass-through later on.

[16] Following the fiscal reaction function literature (see Bohn 1998) we assume that governments adjust the fiscal balance based on the following equation: $balance_t = balance_t^* + d^{debt} (debt_t - debt_t^*) + d^{gap}\ Output\ Gap_t$, in which * indicates the baseline (steady-state) values of the fiscal balance and government debt ratios to GDP, respectively, and d^{debt} and d^{gap} indicate how much the fiscal balance responds to a deviation of debt and the output gap from their steady-state levels, respectively. Our baseline assumptions for these coefficients are $d^{debt} = 0.2$ and $d^{gap} = 0$ for economies in the euro area crisis-hit economies, based on the estimates of Baldi and Staehr (2013). For other economies, we calibrate d^{debt} and d^{gap} based on OECD estimates of fiscal rules (Girouard and André, 2005). In particular, for these other economies, we assume country-specific responses to the business cycle (these suggest that fiscal balances in euro area economies fall by 0.4–0.5 percent of GDP for each percentage point fall in output) and a debt response coefficient of 0.05.

[17] To explore a more accommodative approach, we recalibrate the fiscal reaction function based on evidence on the strength of automatic stabilizers in the literature. In particular, we recalibrate the fiscal reaction functions, country by country, in line with the estimates of Girouard and André (2005), which suggest that fiscal balances in euro area economies fall by 0.4–0.5 percent of GDP for each percentage point fall in output. In addition, we assume that fiscal balances rise by only 0.05 percentage point for each percentage point rise in the debt-to-GDP ratio, instead of the 0.2 percentage point rise in the benchmark scenario. The 0.05 percentage point response is in line with estimates in the literature for advanced economies before the crisis (Bohn, 1998; Baldi and Staehr, 2013). Under this more accommodative fiscal rule, domestic demand is generally stronger but not to an extent such that it changes the results qualitatively.

[18] Other fiscal instruments, such as government investment, would imply a larger (multiplier) contraction in output if used to implement the fiscal adjustment.

Main results

21.   **The simulation results show that the short-term effect of wage moderation on economic activity is larger, the fewer economies are undertaking it.** Broadly speaking, there are two effects at play in the crisis-hit economies:

- **A competitiveness effect, which is positive**: The contribution of exports to growth rises. This rise in exports, by generating higher incomes and wealth, also supports consumption and, to keep up with higher demand, additional investment.

- **A demand effect, which is negative**: In the first two years, there is also a rise in real interest rates, which moderates the boost to consumption and investment. In particular, as nominal interest rates do not respond to the disinflationary effects of lower wage inflation in this setting, real interest rates rise above baseline for the first two years.

The initial response of domestic demand in the crisis-hit economies thus reflects the combination of a positive effect due to additional income from exports and a negative effect from higher real interest rates because monetary policy is constrained by the ZLB.[19,20]

22.   **The more countries undertake wage moderation together, the smaller is the competitiveness effect and the larger is the demand effect and thus the smaller the benefits and the larger the costs of wage moderation for these economies.**

- In the case of a single euro area crisis-hit economy undertaking wage moderation alone, the net result on output is strongly positive. The red lines in Figure 1 report the average effect on a single euro area crisis-hit economy reducing wage inflation by 2 percentage points.[21] In this case, the fall in nominal wage inflation boosts the level of real GDP by about 1 percent relative to baseline by the second year and almost 2 percent by the third year, with much of the benefit coming from a rise in exports.

- The blue lines in Figure 1 show that when all crisis-hit economies—which account for roughly one-third of euro area GDP—moderate their wage growth 2 percent below baseline, then this yields only a 1 percent expansion in output by the third year, which is half as large as the expansion in response to moderation by a single crisis-hit economy. The contribution of net exports to GDP relative to baseline is still positive, while the contributions of consumption and investment are now both initially negative. However, exports no longer rise as strongly as they do in the single-country wage moderation case, mainly reflecting lower demand from euro area

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[19] A smaller pass-through from wages to domestic prices substantially reduces the negative effect on investment.

[20] To the extent that rising output reduces risk premiums, wage moderation in the crisis-hit economies leads to a somewhat larger expansion in output as the demand effect is less negative.

[21] The average effect is obtained by running the simulation for each euro area crisis-hit economy separately, and then averaging the results based on GDP weights. The effects would be stronger for economies that are smaller than the average and weaker for those that are larger.

partner countries.[22] The lower exports imply lower income and wealth for households and firms than in the single-country case. Real interest rates are somewhat higher than in the single-country case, further constraining internal demand. In addition, the government debt-to-GDP ratio rises slightly more here, reflecting the reduced level of nominal GDP and higher real interest rates, and this prompts the government to tighten fiscal policy, in line with the fiscal reaction function already mentioned. [23,24]

- Although wage moderation in all euro area economies has not been considered a sensible policy proposition, we present it as a scenario for illustrative purposes. Note that when all euro area economies moderate their wage and price growth by 2 percent, this action results in a loss in output by about 1 percent by the third year. Put simply, the positive competitiveness effect is now even weaker and the negative demand effect so much stronger that it pulls down output below baseline. The reason for this outcome is that euro area economies trade to a large extent with one another: intra-euro area trade accounts for nearly half of total euro area trade, and euro area countries nowadays exchange goods and services equivalent to about 20 percent of euro area GDP per year (ECB, 2013).

- A more sensible proposition than across-the-board wage moderation is moderation in crisis-hit economies combined with wage increases in those economies that feature larger-than-warranted current account surpluses.[25]

23.   **Wage and price moderation in crisis-hit economies has adverse spillover effects on euro area partner countries.** Thus far, we have discussed the effect of wage moderation on output from the perspective of countries that are undertaking it. The next step is to study the spillovers of wage moderation. We do so for the scenario in which all the crisis-hit economies implement wage moderation together. The blue lines in Figure 2 show the positive effect on output in the crisis-hit economies, exactly as do the blue lines in Figure 1. The blue lines in Figure 3 show that output of euro area partners contracts by about 1¼ percent relative to baseline by the third year. The blue

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[22] It is worth clarifying that the current account balance-to-GDP ratio still improves here, as in the single-country wage moderation case. The composition of the improvement is, however, now due more to a decline in imports than a rise in exports.

[23] With the more accommodative fiscal rule, the expansion would be about 1.2 percent by the third year, rather than 1 percent. While the fiscal balance is raised more in response to higher GDP because automatic stabilizers are allowed to play freely, it is raised less in response to the increase in the nominal debt ratio because of the fall in prices. The second effect dominates the first.

[24] The contractionary effect of this fiscal tightening on output is substantially greater when the fiscal adjustment occurs through cuts in government consumption, government investment, or direct transfers to credit-constrained households (results not reported here).

[25] This possibility is entertained in IMF (2015a) by considering the effects of an increase in nominal wages in Germany on the rest of the euro area. This has two effects. First, the redistribution from capital to labor raises aggregate demand, which is consistent with the effects described in the simulations here. Second, the assumption of sticky prices leads to an increase in real product wages, which induces firms to cut back on employment and lowers aggregate demand. This second channel is ruled out here, as the simulations consider a coordinated change in wages and prices wherein the real product wage is constant. Thus, if a coordinated increase in wages and prices could be obtained, it would strengthen the competiveness effects of wage moderation in the crisis-hit economies and diminish the adverse demand effects of wage moderation everywhere.

lines in Figure 4 show that the net effect on output of the euro area as a whole is modestly negative in the short run: a contraction of about ½ percent relative to baseline by year 3.[26]

24.   **Several effects are playing out in reducing GDP in partner countries by 1¼ percent relative to baseline** (as illustrated in Figure 5 and discussed further in the Appendix)**.**

- **Less demand in crisis-hit economies for goods and services produced by euro area partners**. This development has three dimensions. First, cyclical effects in crisis-hit economies (relatively less demand for goods—notably durables rather than services—in recessions) play only a negligible role. Second, crisis-hit countries import less goods and services from partner countries because their home-produced goods and services have become cheaper—this is purely the expenditure switching effect in response to improved competitiveness in their import equation. This effect is small. Third, crisis-hit economies' expenditure, notably on consumption, declines below baseline through the second year and this holds back imports. This reflects the decline in households' real consumption wages and thus the demand effect in their import equation.[27] This effect on euro partner country GDP is not large—less than ¼ percent of GDP. The reason is that the share of crisis-hit economies in partner countries' exports is not large.

- **More demand in euro area partners for goods and services produced by crisis-hit economies and the rest of the world**. Agents in partner countries now spend a smaller proportion of their incomes on home-produced goods and services because those of the crisis-hit economies have become cheaper as a result of wage moderation. This development is purely the expenditure switching effect in response to lower competitiveness in their import equation and accounts for a ¼ percent decline in GDP. Additionally, these agents now also spend a greater share of their incomes on goods and services produced in the rest of the world because the exchange rate of the euro appreciates as real interest rates rise. This accounts for another ¼ percent decline in their GDP.

- **Higher real interest rates** reduce consumption, investment, and output in the partner economies. This accounts for a bit more than a ½ percent decline in partner country GDP and is by far the largest negative effect. It also explains why, notwithstanding relatively cheaper goods and services in the crisis-hit economies and the rest of the world, partner country imports drop, making a "positive" contribution to GDP growth (Figure 3, blue line). This real interest rates effect can be thought of as capturing the second round effects of falling competitiveness in the partner countries. Partner country wages drop in response to rising unemployment; their prices fall in tandem with wages, real interest rates rise and cut consumption and investment, which raises unemployment further and so forth until a new equilibrium is found.

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[26] The global spillovers are small but not negligible: in year 2 output in the rest of the world is lower than baseline by nearly 0.05 percent.

[27] Note that the first effect only captures the extent to which demand for imports declines beyond what can be explained with the decline in real consumption wages—this mimics the large decline in consumption of durable goods during recessions, which are traded to a greater extent than non-durable goods.

25.   **The main factor behind the drop in euro area output in response to wage moderation in the crisis-hit economies, notwithstanding an expansion in output in the crisis-hit economies, is the ZLB**. Figure 6 shows the effects under the scenario when the ZLB is not binding. Real interest rates then are broadly flat and output expands. Relative to the scenario when the ZLB binds, real interest rates are then about ¾ percentage points lower starting in year 2 and output is 1 percent higher.

Exploring the channels

26.   **We now report the results of additional simulations that explore the respective roles of macroeconomic and structural policies in influencing the effect of wage moderation.** Given that the policy debate has emphasized the need for wage and price moderation in euro area crisis-hit economies, we start with the hypothetical scenario in which all euro area crisis-hit economies pursue the 2 percentage point reduction in wage and price inflation at the same time. Furthermore, considering the role of the ZLB in determining the outcome of wage moderation and IMF staff support for highly accommodative monetary conditions and structural reforms, we focus on the role of these policies.

Monetary policy response

27.   **To explore how wage moderation would affect output in settings in which monetary policy is more supportive, we now model the impact of QE that achieves a 50 basis point reduction in the term premium on long-term interest rates**. This scenario is motivated by the view that, even after policy rates hit the ZLB, central banks can provide support to economic activity. IMF advice has emphasized the role of monetary policy in shoring up the recovery and the importance of achieving the inflation target to facilitate rebalancing within the euro area. Measures include further unconventional policies, notably direct purchases of select private assets or sovereign bonds, as is the current practice of the European Central Bank (ECB). Further measures include repairing bank balance sheets and making further progress on a banking union to restore confidence in the financial system, weaken bank-sovereign adverse loops, reduce fragmentation, and thus support credit and growth (see IMF, 2013a). Examining the role of such specific measures lies outside the scope of our modeling framework. A main objective, however, is to restore the monetary transmission mechanism and the ability of the ECB to influence growth and inflation, as well as to reduce risk premiums over policy rates.[28],[29]

28.   **When monetary policy is able to reduce the term premium by 50 basis points, the process of wage moderation has large positive effects on output in the crisis-hit economies**

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[28] It is also worth acknowledging that the evidence regarding the effect of unconventional monetary policies on output is not clear cut (see IMF, 2013b, for an overview). Chung and others (2012) conclude that "the Federal Reserve's asset purchases, while materially improving macroeconomic conditions, did not prevent the ZLB constraint from having first-order adverse effects on real activity and inflation."

[29] The simulations under the assumption that the share of liquidity constrained households is 70 percent rather than 35 percent show that the positive effect of wage moderation on crisis-hit economies is smaller and the negative effect on other euro area economies—and on overall euro area output—a bit larger. This finding illustrates the usefulness of repairing the monetary transmission channel.

(Figure 2, red line) and a small positive effect on the euro area as a whole (Figure 4, red line).
In response to the reduction in (euro-wide) inflation, the central bank's monetary stimulus results in
a boost to output in the euro area crisis-hit economies of more than [1] percent relative to baseline
within two years and nearly [1½] percent within three years. However, the impact of the 50 basis
point reduction in the term premium is not large enough to lift output in the euro area partner
economies above baseline (Figure 3). A stronger effect could, in principle, be achieved with a
stronger monetary policy response, although in some countries the room to lower risk premiums on
long-term rates has already become very small. An alternative would be a fiscal policy expansion in
the partner countries with fiscal space. Such an expansion would raise domestic demand in the
partner economies, facilitating adjustment in the crisis-hit economies. In practice, however, partner
economies have relatively high fiscal deficits and government debt, with the notable exception of
Germany. For an exploration of policies along these lines, see Blanchard, Erceg, and Lindé (2015) and
IMF (2015b).

29.   **The effect of QE on the rest of the world is positive**. Two effects are at work. First, QE
raises domestic demand in all euro area economies and, consequently, they import from the rest of
the world. Second, QE leads to a depreciation of the euro's exchange rate, which redistributes
demand for the rest of the world to the euro area. However, in response to their appreciating
currencies and falling inflationary pressure, foreign central banks can ease monetary policy.
Together, these factors lead to a very modest expansion in output in the rest of the world, rather
than a very modest contraction in the case of wage moderation without QE.

Rising markups

30.   **We now drop the assumption of a constant markup, allowing it to increase in response
to wage moderation in the crisis-hit economies**. Accordingly, real product wages decline and
there now is redistribution of income from labor to capital (Figure 7). However, the distributional
effects cannot be captured in the model. What is captured is the rise in firms' profitability and the
reduction in the real market interest rate that come with higher prices, which boosts investment.
However, the smaller decline in domestic prices also implies that the improvement in external
competitiveness is muted and real GDP expands by less than in the case of full pass-through of
wage moderation to prices. As a result, the spillovers on partner country GDP are less negative.
Overall, output expands less in the crisis-hit economies and falls less in the euro area as a whole.

Structural reforms

31.   **We now add the new structural reforms under the G20 Comprehensive Growth
Strategy (launched in Australia in 2014) on top of monetary policy easing**. Specifically, we
consider the following reforms and their impact on total factor productivity (TFP), employment, or
directly on GDP (countries mentioned in parentheses are planning initiatives with an appreciable
impact on growth):[30] product market reforms (France, Germany, Italy, Spain—TFP); research and

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[30] For a detailed write up of these commitments, see https://g20.org/wp-
content/uploads/2014/12/g20_comprehensive_growth_strategy_european_union.pdf. Countries not mentioned in

development initiatives (Spain—TFP); reforming employment protection (France, Germany, Italy, Spain—TFP); tax reforms (France, Italy—TFP/employment); active labor market policies and unemployment benefit replacement changes (France, Germany, Italy, Spain—employment); childcare and maternity programs (France, Germany, Italy—employment); pension reforms (France—employment); infrastructure (Germany—GDP).[31] A detailed write up of these reform commitments can be found on the G20 website, under the section covering the Australian presidency in 2014.[32] Countries not mentioned in the parentheses may still implement such reforms but, at the time of the launch of the G20 comprehensive growth strategy in Brisbane, these countries were not assessed to have a large impact.

32.   **The effects of a strategy that includes wage moderation in the crisis-hit economies, QE, and ambitious structural reforms have a large positive impact on output everywhere**. As shown in the black lines (Figure 2), in the crisis-hit economies output is about [1½] percent higher within 2 years and 2½ percent higher in 3 years. In their euro area partners, the figures are ¼ and ½ percent, respectively (Figure 3). A caveat: the simulations assume that structural reforms are fully credible and thus quickly impact investment. Uncertainty exists, however, about how strong this channel would be in practice. Furthermore, we do not account for reallocation costs.

33.   **The effects of reforms that raise TFP differ from those of reforms that raise labor supply**. The former raise real wages; the latter reduce real wages (Figure 8). Consumption and investment rise under both types of reforms but, in the short run, to a greater extent under TFP reforms.

III.   POLICY LESSONS

34.   **Monetary policy needs to take into account the disinflationary impact of wage and price moderation to support a sustainable, broad-based, and positive response of euro area countries' employment and output**. An incomes policy that achieves across-the-board wage and price moderation in the crisis-hit economies can boost their output but can also produce negative spillovers on output of their euro area partner economies. In the short run, several factors determine the effects of wage and price moderation on employment and output. Wage moderation is likely to increase external competitiveness and net exports. However, lower wage growth is likely to add to existing disinflation pressures, implying higher real interest rates, higher real public and private debt levels, and lower domestic demand. The simulations suggest that the net effects of wage moderation in crisis-hit economies are positive for their economies, but those effects decrease when all crisis-hit economies moderate their wages at the same time. Under such circumstances, lower demand in the euro area crisis-hit economies along with lower competitiveness in their euro

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the brackets may still implement such reforms but, at the time of the launch of the G20 strategy, these countries were not assessed to have a large impact.

[31] Notice that reforms that raise TFP have different effects than reforms that raise employment. The former raise wages, while the latter reduce wages. Accordingly, the former have positive spillovers, while the latter have negative spillovers in the short run.

[32] See https://g20.org/resources/past-presidencies/ and https://g20.org/wp-content/uploads/2014/12/g20 for further information on each country's comprehensive growth strategy.

area partner economies can mean that output in the latter falls below baseline. The result is a small negative effect for the euro area as a whole, mainly because monetary policy cannot ease in response to lower inflation, as the policy rate is at the ZLB.

35.   **IMF staff has consistently advocated an accommodative monetary policy in response to falling wage and price inflation pressure, including QE, as well as structural reforms and fiscal easing in countries with room for policy maneuver**. The simulations here focus on wage moderation and QE and show that together these policies would have positive effects for not only the crisis-hit economies but also their euro area partner countries. The result is a positive effect on output in the euro area as a whole. Importantly, structural reforms that boost TFP have a stronger, supportive effect on consumption and investment in the short run than reforms that boost labor supply. We see the results as consistent with unconventional monetary support (and other measures to help reverse financial fragmentation) underway and the calls for further structural reforms, notably measures that boost productivity.[33]

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[33] A similar scenario is discussed in the 2013 Spillover Report (IMF, 2013c). As the Spillover Report explains, the combination of these measures at the national level could, together with policies at the euro area level (fuller banking union, with appropriate common backstops; and further unconventional monetary policy measures), have substantial positive effects on output in the euro area and beyond.

Figure 1. Wage Moderation Scenarios
Together with rest of EA crisis-hit economies
Alone
Together with rest of EA

Real GDP
(percent difference)

Wage Inflation
(percent point difference)

Real Consumption
(percent point contribution to real GDP)

Real Investment
(percent point contribution to real GDP)

Real Exports
(percent point contribution to real GDP)

Real Imports
(percent point contribution to real GDP)

Real Market interest Rate
(percent point difference)

Government Debt
(percent point of GDP difference)

Source: IMF European and Research Departments.

Note: Scenarios show the average effect in the following economies: Greece, Ireland, Italy, Portugal, and Spain.

Figure 2. Euro Area Crisis-hit Economies
Wage moderation in the crisis-hit EA economies
Add quantitative easing
Add implementing EA G20 Growth-Strategy Commitments
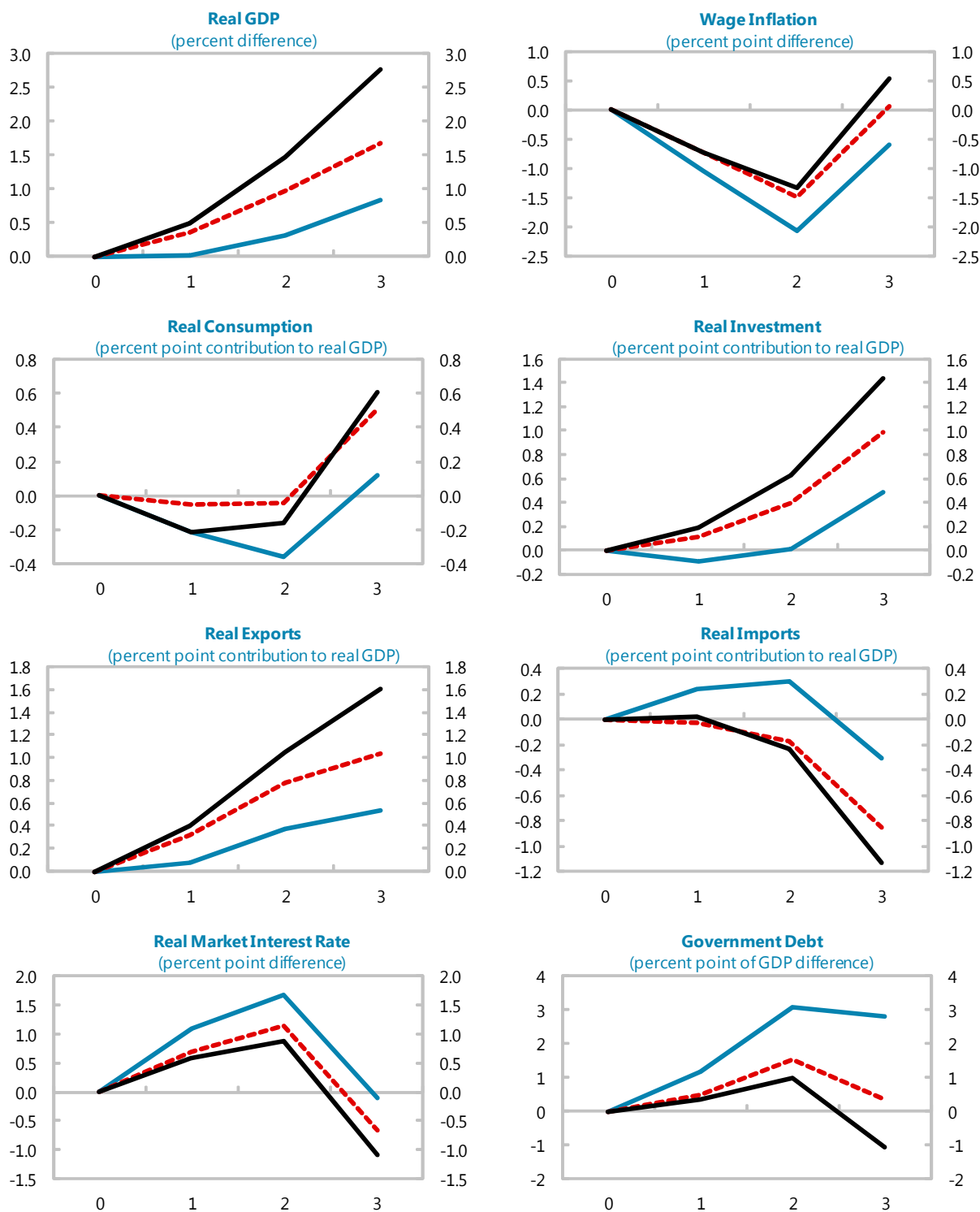
Source: IMF European and Research Departments.

Note: Crisis-hit economies include those that experienced or still feature a large risk premium on their goverment bonds: Greece, Ireland, Italy, Portugal, and Spain.

Figure 3. Other Euro Area Economies
Wage moderation in the crisis-hit EA economies
Add quantitative easing
Add implementing EA G20 Growth-Strategy Commitments

Real GDP
(percent difference)

Wage Inflation
(percent point difference)

Real Consumption
(percent point contribution to real GDP)

Real Investment
(percent point contribution to real GDP)

Real Exports
(percent point contribution to real GDP)

Real Imports
(percent point contributiono to real GDP)

Real Market Interest Rate
(percent point difference)

Government Debt
(percent pointof GDP difference)
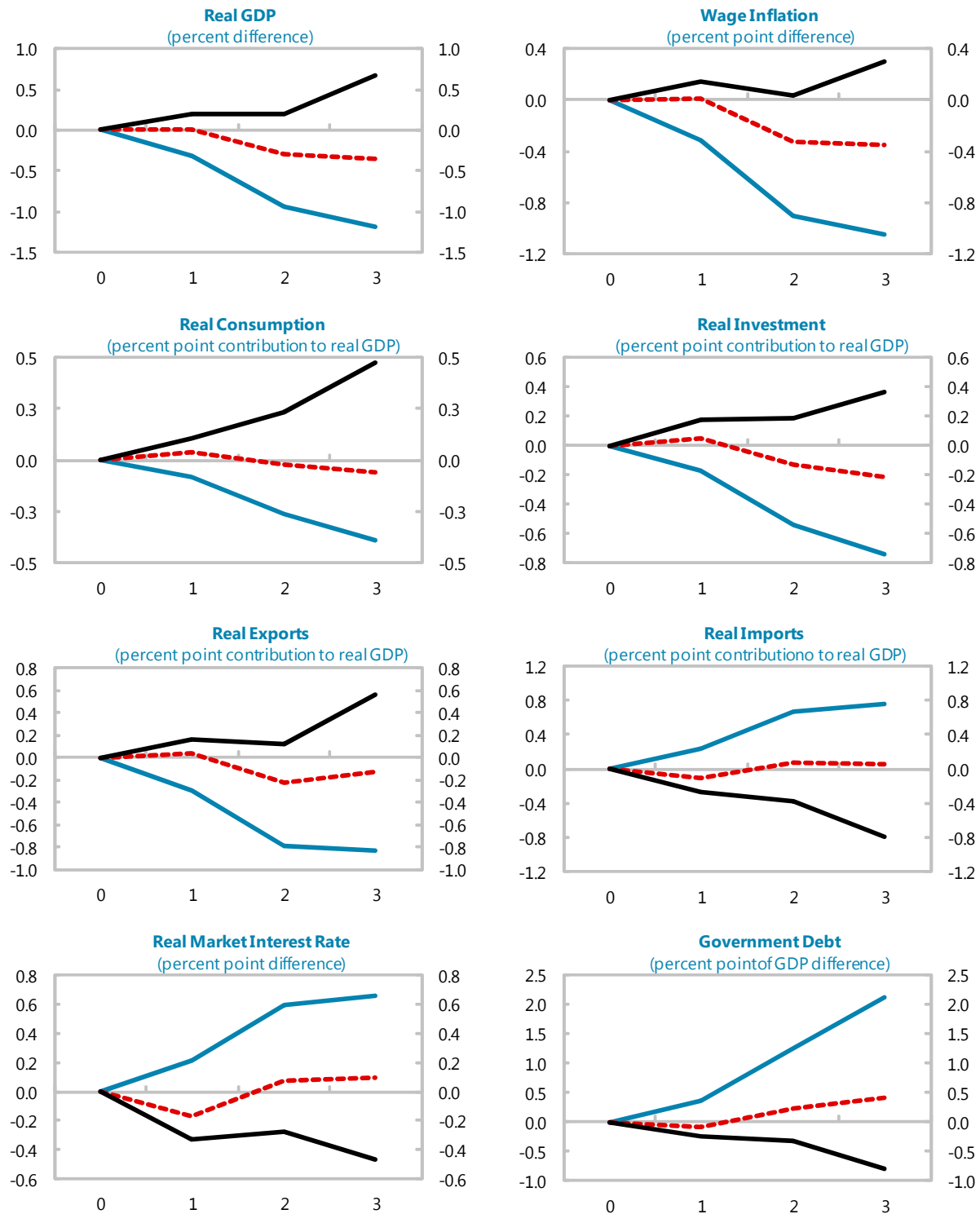
Source: IMF European and Research Departments.

Figure 4. Euro Area Aggregate
Wage moderation in the crisis-hit EA economies
Add quantitative easing
Add implementing EA G20 Growth-Strategy Commitments

Real GDP
(percent difference)

Wage Inflation
(percent point difference)

Real Consumption
(percent point contribution to real GDP)

Real Investment
(percent point contribution to real GDP)

Real Exports
(percent point contribution to real GDP)

Real Imports
(percent point contribution to real GDP)

Real Market Interest Rate
(percent point difference)

Government Debt
(pe of GDP difference)
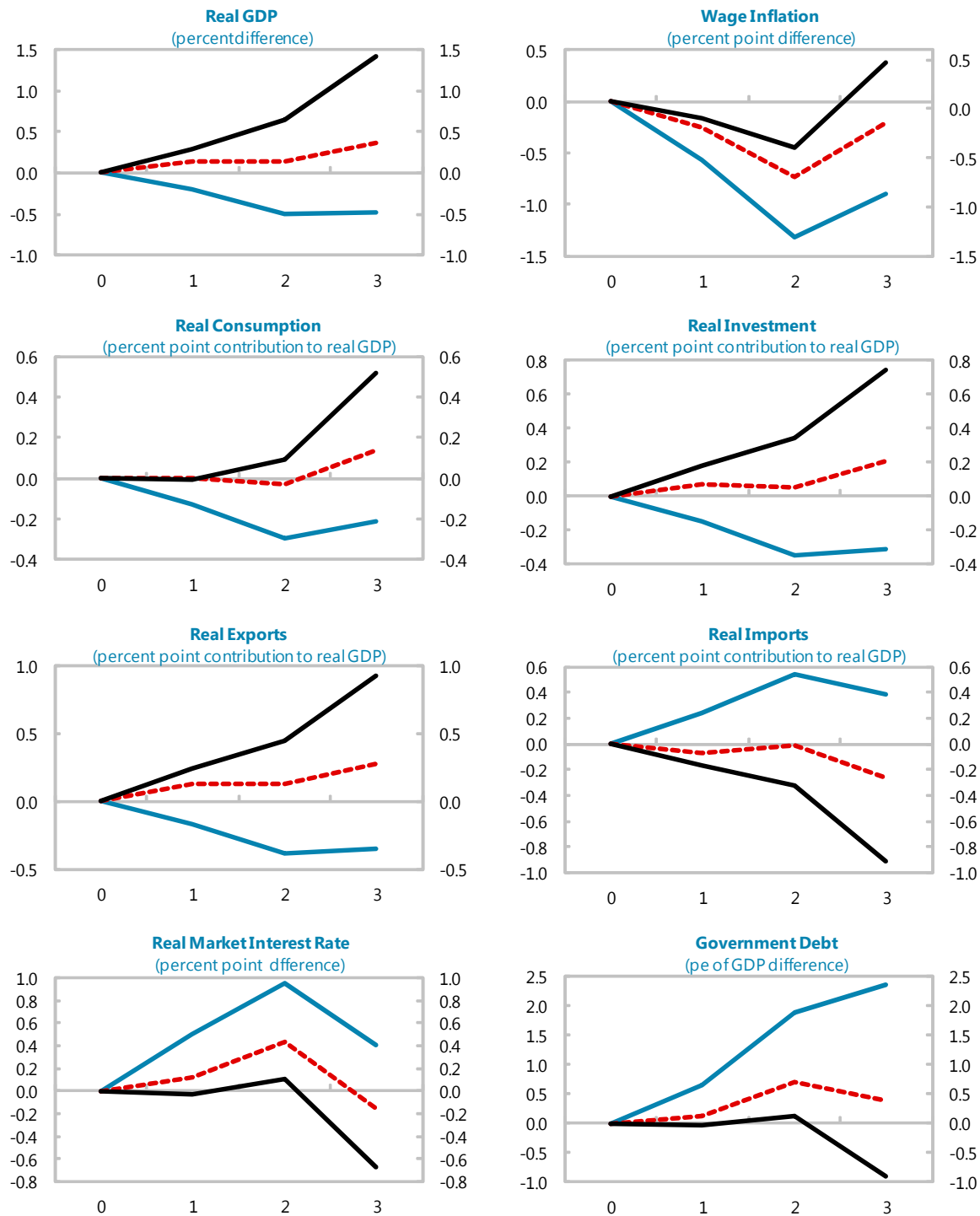
Source: IMF European and Research Departments.

Figure 5. Spillover Effects From Crisis-Hit on Other GDP (%)

Effect of output gap in crisis countries' import equation
Add effect of prices in crisis countries' import equation
Add effect of foreign activity in other's exports
Add effect of prices in other's imports
Add effect of prices in other's exports
Add other effects
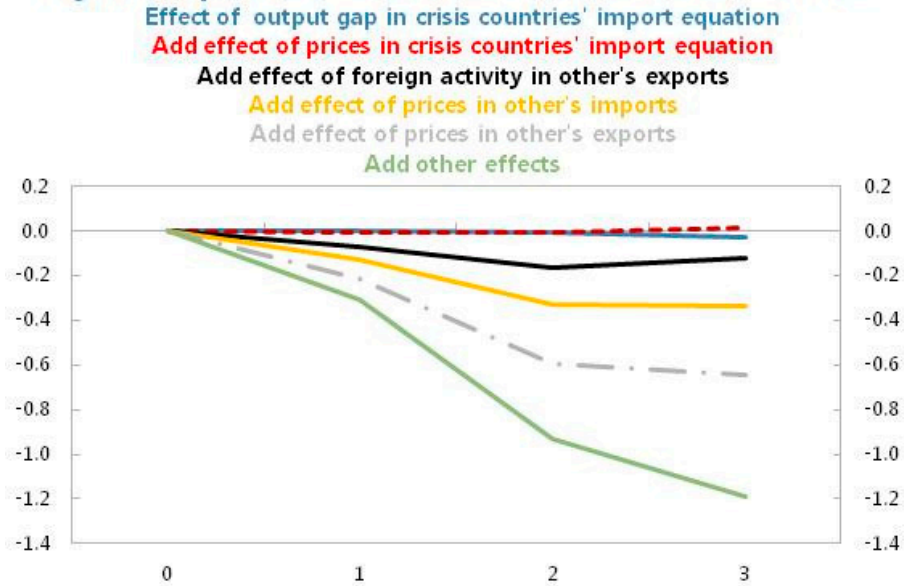
Source: IMF European and Research Departments.

Figure 6. Euro Area Aggregate

Monetary policy constrained by zero lower bound
No zero lower bound

Real GDP
(percent difference)

Real Market Interest Rate
(percent point difference)
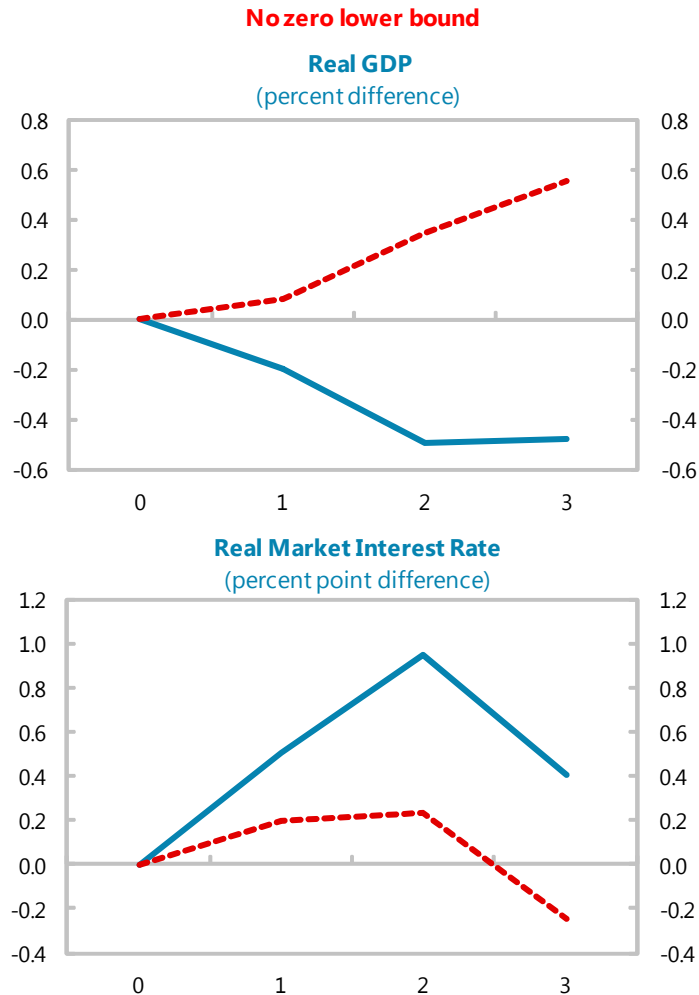
Source: IMF European and Research Departments.

Figure 7. Full versus Incomplete Pass-through of Wage Moderation

Euro Area Crisis-hit Economies: Real GDP Level
(percent deviation)

Benchmark (full pass-through)
Incomplete (50 percent) pass-through

Euro Area Aggregate: Real GDP Level
(percent deviation)

Benchmark (full pass-through)
Incomplete (50 percent) pass-through

Euro Area Crisis-hit Economies: Real Wage
(percent deviation)

Benchmark (full pass-through)
Incomplete (50 percent) pass-through

Euro Area Aggregate: Real Wage
(percent deviation)

Benchmark (full pass-through)
Incomplete (50 percent) pass-through

Euro Area Crisis-hit Economies: Real Market Interest Rate
(percentage point deviation)

Benchmark (full pass-through)
Incomplete (50 percent) pass-through

Euro Area Aggregate: Real Market Interest Rate
(percentage point deviation)

Benchmark (full pass-through)
Incomplete (50 percent) pass-through

Source: IMF European and Research Departments.

Figure 8. TFP versus Labor Supply Reform [1]/

Real GDP Level
(Percent deviation)

Real Private Investment
(Percent deviation)

Real Consumption
(Percent deviation)

Real Wage
(Percent deviation)

Wage Inflation
(Percent point deviation)

Real market interest rate
(Percent point deviation)
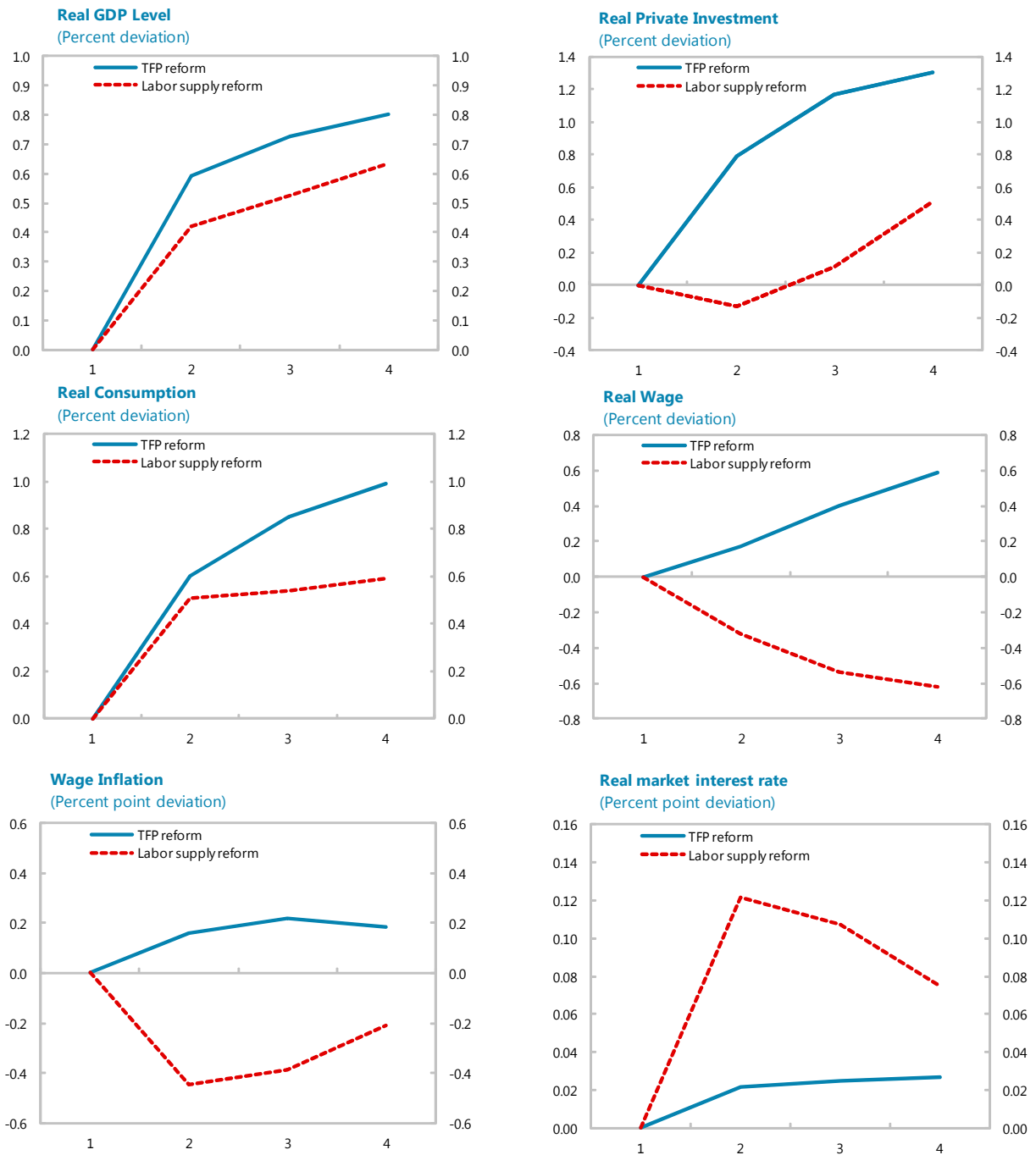
Source: IMF European and Research Departments
[1]/ Calibrated to yield a 1 percent expansion in real GDP over the long run.

APPENDIX

Section A.1 of this appendix provides some background on EUROMOD—the model used in the main text of the paper. The next section is an overview of the model (Section A.2)—based on Andrle and others (2014)—followed by a detailed quantification of the channels through which wage moderation in crisis countries has negative spillovers on activity in partner countries (Section A.3).

A.1   About EUROMOD

The work in this paper is based on a new suite of dynamic stochastic general equilibrium models developed at the IMF, which can handle a larger number of country blocks than the IMF's other models such as the Global Economic Model (GEM) and the Global Integrated Monetary and Fiscal Model (GIMF). The particular model used here is called EUROMOD. It contains a block for each of the 11 major euro area countries plus 13 other blocks:

- 11 euro area countries: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain.

- 7 other countries: China, India, Japan, Sweden, Switzerland, the United Kingdom, and the United States.

- 6 regions: Newly Industrialized Asia excluding China and India, Other European Union, Latin America, Other Advanced Economies, Oil Exporters, and the Rest of the World

To accommodate a computationally feasible model with 24 blocks, the structure of EUROMOD is simplified relative to GIMF and GEM. The model is semi-structural, with some elements such as private consumption and investment having micro-foundations, while others—such as trade, labor supply, and inflation—with reduced-form representations.

A.2   EUROMOD Overview

Aggregate Demand

▪ **Private Consumption:** There are two types of households in the model, overlapping generations (OLG) households that can accumulate and draw down from wealth and liquidity-constrained (LIQ) households that can only consume out of their current labor income and net transfers from the government.

▪ **Private Investment:** A version of Tobin's q model with quadratic real adjustment costs is used. Investment is negatively correlated with real interest rates. Investment cumulates to the private business capital stock, which is chosen by firms to maximize their profits. The capital-to-GDP ratio is

inversely related to the cost of capital, which is a function of depreciation, the real interest rate, the corporate tax rate, and relative prices.

▪ **Public Absorption:** Government absorption consists of spending on consumption and investment goods. Government consumption spending only affects the level of aggregate demand. It is an exogenous choice determined by the fiscal authority. The level of government investment is also chosen exogenously, but in addition to affecting aggregate demand directly it also cumulates into a public capital stock, which can be thought of as public infrastructure (roads, buildings, etc.). A permanent increase in the public capital stock permanently raises the economy-wide level of productivity.

▪ **Net Exports:** The real competitiveness index (RCI) is the long-run determinant of the level of net exports that adjust to achieve the current account balance required to support the desired net foreign asset position. Exports and imports, individually, are modeled as reduced-form equations. Exports increase with foreign activity, and are also an increasing function of the depreciation in the RCI. Imports increase with domestic activity, and are an increasing function of the appreciation of the real effective exchange rate (REER). The trade equations are described in greater detail in Section A.3 of this appendix.

Aggregate Supply: Aggregate supply is captured by potential output, which is based on Cobb-Douglas production technology with trend total factor productivity, the steady-state labor force, the non-accelerating inflation rate of unemployment (NAIRU), and the actual capital stock.

Monetary and Fiscal Policy: The behavior of monetary authorities is represented by an interest rate reaction function. The standard form is an inflation-forecast-based rule operating under a flexible exchange rate. However, the form of the interest rate reaction function is such that there is scope for a fixed exchange rate regime, monetary union, or a managed floating exchange rate regime.
The model also contains a 10-year interest rate that is based on the expectations theory of the term structure, plus a term premium. The interest rates on consumption, investment, government debt and net foreign assets are weighted averages of the 1-year and 10-year interest rates, reflecting their differing term structures, and allowing for a meaningful role for the term premium.
The fiscal authority chooses a long-run level of debt relative to GDP (or conversely, a long-run deficit target). In order to meet its debt or deficit targets as well as spending obligations, it can tax, using consumption taxes (VAT), labor income taxes, corporate income taxes, and lump sum taxes. In the face of shocks to the economy under the standard fiscal reaction function, all tax rates remain fixed and spending on general lump sum transfers adjusts to ensure that the public debt-to-GDP ratio is maintained in the medium term. However, the fiscal reaction function can also be specified to use other instruments besides general transfers.

Wages and Prices: The core price in all regions is the consumer price index excluding food and energy, CPIX, which is determined by an inflation Phillips curve. The form of the Phillips curve is consistent with a hybrid New Keynesian Phillips curve, in which there are both expectational dynamics from the expected future inflation and inertial dynamics from past inflation. The degree of forward-looking behavior in inflation is country specific. In addition, there is a Phillips curve for

nominal wage growth. Wage inflation exhibits stickiness and allows the real wage to return to its equilibrium only gradually, depending on the expected evolution of overall economic activity.

A.3   Spillovers

Several effects contribute to reducing GDP in partner countries by 1¼ percent by year 3 relative to baseline (as illustrated in Figure 5 in the main text). The key parameters and elasticities that play a role in governing the magnitude of this effect are described below (and the full set of trade elasticities in the model is given in Tables A.1 to A.4).

1) **Less demand in crisis-hit economies for goods and services produced by euro area partners**. Crisis-hit economies' expenditure, notably on consumption, declines below baseline through the second year and this holds back imports. The decline in households' real consumption wages reduces consumption and generates the demand effect in crisis economies import equations. This effect on euro partner country GDP is about ¼ percent of GDP.

   ►The magnitude of this effect depends on the elasticity of imports with respect to activity for crisis economies (which ranges from 0.9 to 1.4—see Table A.1) and the share of crisis-hit countries imports from partner countries (which ranges from 0.2 to 0.4—see Table A.2).

2) **More demand in euro area partners for goods and services produced by crisis-hit economies and the rest of the world**.

   Agents in partner countries now spend a smaller proportion of their income on home-produced goods and services because those of the crisis-hit economies have become cheaper as a result of wage moderation—this is purely the expenditure switching effect in response to lower import prices in their import equations and accounts for a ¼ percent decline in GDP.

   ► This effect depends on the relative price elasticity of imports in partner countries—which ranges from –0.6 to –0.9 (see Table A.1) and the share of partner country imports from crisis countries (about 10 percent—see Table A.2).

   Additionally, these agents now also spend a greater share of their incomes on goods and services produced in the rest of the world because the exchange rate of the euro appreciates as real interest rates rise. This accounts for another ¼ percent decline in their GDP.

   ► This effect also depends on the relative price elasticity of imports in partner countries, which ranges from –0.6 to –0.9 (see Table A.1). About 60 percent of partner country imports are from the rest of the world (see Table A.2).

3) **Higher real interest rates** reduce consumption, investment, and output in the partner economies. This trend accounts for a bit more than a ½ percent decline in partner country GDP. A rule of thumb from this type of DSGE model is that a 100 basis points increase in interest rates

sustained for a year lowers GDP by 0.3 percent relative to baseline. In our case, we have an increase of 60 basis points, but it is much more persistent.

Table A.1. Trade Elasticities

Country Group	Import Equations		Export Equations	
	Activity	**Relative Price**	**Activity**	**Relative Price**
Crisis Countries				
Greece	1.40	-0.75	1.00	-0.58
Italy	1.10	-0.64	1.00	-0.49
Ireland	0.88	-0.96	1.00	-0.63
Portugal	1.10	-0.48	1.00	-0.22
Spain	1.40	-0.75	1.00	-0.58
Partner Countries				
Austria	0.98	-0.64	1.00	-0.35
Belgium	0.70	-0.64	1.00	-0.30
Finland	1.05	-0.75	1.00	-0.58
France	1.29	-0.64	1.00	-0.49
Germany	1.05	-0.75	1.00	-0.58
Netherlands	0.90	-0.85	1.00	-0.79

Table A.2. Import Weights

	Crisis Countries	**Partner Countries**	**Rest of the World**
Greece	0.17	0.33	0.50
Italy	0.07	0.41	0.52
Ireland	0.04	0.21	0.75
Portugal	0.43	0.33	0.25
Spain	0.13	0.36	0.50

Austria	0.09	0.48	0.43
Belgium	0.11	0.43	0.46
Finland	0.06	0.33	0.60
France	0.17	0.34	0.49
Germany	0.11	0.26	0.63
Netherlands	0.07	0.37	0.56

Table A.3. Export Weights

	Crisis Countries	Partner Countries	Rest of the World
Greece	0.12	0.23	0.66
Italy	0.07	0.33	0.60
Ireland	0.07	0.31	0.62
Portugal	0.29	0.36	0.34
Spain	0.16	0.36	0.47
Austria	0.10	0.38	0.52
Belgium	0.09	0.48	0.43
Finland	0.05	0.21	0.74
France	0.17	0.29	0.53
Germany	0.11	0.26	0.63
Netherlands	0.10	0.46	0.44

Table A.4. Trade Weights in Price of Foreign Markets Equation

	Crisis Countries	Partner Countries	Rest of the World
Greece	0.09	0.25	0.66
Italy	0.05	0.25	0.70
Ireland	0.07	0.23	0.71
Portugal	0.09	0.26	0.65
Spain	0.07	0.26	0.67
Austria	0.10	0.22	0.68
Belgium	0.11	0.21	0.69
Finland	0.08	0.22	0.71
France	0.09	0.18	0.73
Germany	0.11	0.12	0.76
Netherlands	0.11	0.25	0.64

References

Andrle, Michal, Patrick Blagrave, Pedro Espaillat, Keiko Honjo, Benjamin Hunt, Mika Kortelainen, René Lalonde, Douglas Laxton, Eleonora Mavroeidi, Dirk Muir, and Susanna Mursula. 2014. "The Flexible System of Global Models–FSGM." IMF Working Paper 15/64, International Monetary Fund, Washington.

Baldi, Guido, and Karsten Staehr. 2013. "The European Debt Crisis and Fiscal Reaction Functions in Europe 2000–2012." Discussion Paper, German Institute for Economic Research, Berlin.

Bean, Charles. 1998. "The Interaction of Aggregate-Demand Policies and Labour Market Reform." *Swedish Economic Policy Review* 5(2): 352–83.

Blagrave, Patrick, Claudia Godbout, and René Lalonde. Forthcoming. "GMUSE: The Bank of Canada Projection Model for the Global Economy." Bank of Canada Technical Report, Ottawa.

Blanchard, Olivier, Christopher J. Erceg, and Jesper Lindé. 2015. "Jump Starting the Euro Area Recovery: Would a Rise in Core Fiscal Spending Help the Periphery?" NBER Working Paper 21426, National Bureau of Economic Research, Cambridge, Massachusetts.

Bohn, Henning. 1998. "The Behavior of U.S. Public Debt and Deficits." *The Quarterly Journal of Economics* 113 (3): 949–63.

Bordon, Anna, Christian Ebeke, and Kazuko Shirono. Forthcoming. "When Do Structural Reforms Work? On the Role of the Business Cycle and Macroeconomic Policy." IMF Working Paper International Monetary Fund, Washington.

Brayton, Flint, and Peter Tinsley, eds. 1996. "A Guide to FRB/US: A Macroeconomic Model of the United States." FEDS Working Paper 1996-42, Federal Reserve Board, Washington.

Charpe, Matthieu, and Stefan Kühn. 2015. "Beggar or Prosper-Thy-Neighbour? The International Spillovers of Labour Cost." ILO Research Paper No. 11, International Labor Organization, Geneva

Chung, Hess, Jean-Philippe Laforte, David Reifschneider, and John C. Williams. 2012. "Have We Underestimated the Likelihood and Severity of Zero Lower Bound Events?" *Journal of Money, Credit and Banking*, 44 (S1): 47–82.

Dao, Mai Chi. 2013. "Foreign Labor Costs and Domestic Employment: What are the Spillovers?" *Journal of International Economics* 89 (1): 154–71

Decressin, Jörg, Petya Koeva Brooks, Thierry Tressel, Shengzu Wang, Joong Shik Kang, and Jay Shambaugh. 2014. "Adjustment in Euro Area Deficit Countries: Progress, Challenges, and Policies," IMF Staff Discussion Note 14/7, International Monetary Fund, Washington.

Eggertsson, Gauti, and Paul Krugman. 2012. "Debt, Deleveraging, and the Liquidity Trap: a Fisher-Minsky-Koo Approach." *The Quarterly Journal of Economics* 127 (3): 1469–513.

European Central Bank (ECB). 2013. (January) *Monthly Bulletin* 59–74.

Galí, Jordi. 2008. *Monetary Policy, Inflation, and the Business Cycle: An Introduction to the New Keynesian Framework*. Princeton: Princeton University Press.

———. 2012. "Notes for a New Guide to Keynes (I): Wages, Aggregate Demand, and Employment." NBER Working Paper 18651. Delivered as the Presidential Address to the 27th Annual Congress of the European Economic Association, held in Málaga, August 27–31, 2012.

———, and Tommaso Monacelli. 2013, "Understanding the Gains from Wage Flexibility: The Exchange Rate Connection." Barcelona GSE Working Paper 746, Barcelona Graduate School of Economics, Barcelona.

Girouard, Nathalie, and Christophe André. 2005. "Measuring Cyclically Adjusted Budget Balances for OECD Countries." OECD Economics Department Working Paper 434, Organisation for Economic Co-operation and Development, Paris.

International Labor Organization (ILO). 2013. *Global Wage Report 2012/13: Wages and Equitable Growth*. Geneva: International Labor Office.

International Monetary Fund (IMF). 2010. "Will it Hurt? The Macroeconomic Effects of Fiscal Consolidation." Chapter 3 in *World Economic Outlook*, Washington, October.

———. 2013a. "Euro Area Policies: 2013 Article IV Consultation." IMF Country Report 13/231, Washington.

———. 2013b. "Unconventional Monetary Policies—Recent Experience and Prospects." IMF Background Paper. Washington.

———. 2013c. "2013 Spillover Report." Washington.

———. 2014. *Jobs and Growth: Supporting the European Recovery*. Washington.

———. 2015a. "Germany: Selected Issues." IMF Country Report 15/188, Washington.

———. 2015b. "Euro Area Policies—Staff Report." IMF Country Report 15/204, Washington.

Kumhof, Michael, Romain Ranciere, and Pablo Winant. Forthcoming. "Inequality, Leverage and Crises: The Case of Endogenous Default." *American Economic Review*.

Merler, Silvia, and Jean Pisani-Ferry. 2012. "Sudden Stops in the Euro Area." Bruegel Policy
Contribution Issue 2012/06.

Schindler, Martin, Helge Berger, Bas Bakker, and Antonio Spilimbergo, eds. 2014. *Jobs and Growth: Supporting the European Recovery*. Washington: International Monetary Fund.