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The Sharing
of Macroeconomic Risk:
Who Loses (and Gains)
from Macroeconomic
Shocks

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ECONOMICS DEPARTMENT

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By Rudiger Ahrend, Jens Arnold and Charlotte Moeser

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ABSTRACT / RÉSUMÉ

The sharing of macroeconomic risk: Who loses (and gains) from macroeconomic shocks

This paper addresses the often neglected question of how macroeconomic risk is shared across and within economies, and identifies reforms that could contribute towards achieving more desirable risk-sharing outcomes. For risk-sharing across countries, the paper discusses possibilities for international insurance as well as shock-spreading and risk-mitigating policies. Within countries, it assesses the possibilities for individuals to protect their wealth, labour and capital income against various forms of macroeconomic risk and discusses the desirable boundaries between private and government-sponsored risk-sharing institutions. The paper then presents new empirical and model-based evidence about how the short-term impact of selected macroeconomic shocks (including financial crises) is shared across different groups of agents, and analyses how such distributional effects are shaped by differences in institutions. For example, individuals on low incomes, and especially young people, seem in general to lose most from adverse macroeconomic shocks. Also, it appears that across countries two broad types of institutions can be identified that facilitate risk sharing between high and low income earners, namely “social protection” and “reallocation-facilitating” institutions. Based on countries’ reliance on these types of institutions, four broad “models” of risk sharing are identified across the OECD and the BRIICS.

JEL Codes: D31; D63; E60; F55; G22; H11; I38

Keywords: macroeconomic shock; financial crises; risk sharing; insurance; redistribution; income; wealth; DSGE; institutions

Le partage du risque macroéconomique : Les perdants (et gagnants) des chocs macroéconomiques

L'article analyse comment les risques macroéconomiques sont répartis au niveau international et individuel. Il propose des réformes qui pourraient contribuer à une meilleure redistribution de ces risques. Premièrement, au niveau international, le papier analyse l'opportunité des dispositifs d'assurance ainsi que des politiques de partage et de réduction des risques macroéconomiques. Deuxièmement, au niveau individuel, l'article évalue comment les individus peuvent protéger leurs patrimoines et revenus du travail et du capital à l'encontre de différents chocs macroéconomiques. Il analyse les limites et rôles souhaitables des dispositifs privés et publics de répartition des risques. Enfin, l'article modélise les effets de court terme de certains chocs macroéconomiques – dont les crises financières – sur différents groupes d'individus et propose une nouvelle analyse empirique de l'impact des institutions sur la répartition des risques macroéconomiques. Les bas revenus, et en particulier les jeunes, semblent les groupes les plus affectés par les chocs macroéconomiques. Les institutions de protection sociale et elles favorisant les transitions apparaissent contribuer à la redistribution des risques entre niveau de revenus. Cette analyse permet d'identifier quatre grands modèles de répartition des risques parmi les pays de l'OCDE et du BRIICS.

Codes JEL: D31 ; D63 ; E60 ; F55 ; G22 ; H11 ; I38

Mots Clés: chocs macroéconomiques ; répartition des risques ; assurance ; redistribution ; revenus ; modèle d'équilibre général à dynamique stochastique ; institutions.

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THE SHARING OF MACROECONOMIC RISK: WHO LOSES (AND GAINS) FROM MACROECONOMIC SHOCKS

by

Rudiger Ahrend, Jens Arnold and Charlotte Moeser¹

Introduction

1. After two decades of what has often been described as the Great Moderation, recent events have been a forceful reminder that economies are still at risk of being affected by – sometimes violent – shocks. The impact of such shocks on different economic agents within society depends upon the nature of the shocks (origin, temporary or permanent, expected versus unexpected change), the time horizon under consideration, and institution-unrelated adjustment mechanisms.² As well, how the impact of shocks will be borne by different groups depends partly on institutions.³ For example, regulatory and social policies, as well as policy responses, seem to have shaped the way in which different population groups have been affected by the recent financial crisis.⁴

2. How shocks such as financial crises, large fiscal consolidations or commodity price shocks affect different population groups raises not only positive issues, but also normative concerns regarding the desirable allocation of shock-driven gains and losses. This has been highlighted by the public outcry over the perceived privatisation of benefits and the subsequent socialisation of losses from financial sector-driven increases in macroeconomic risk. Therefore it is not only interesting to examine the distributional effects of shocks and how these are shaped by institutions, but also to explore possible normative criteria for assessing how the risk should be allocated across society *ex ante*. Such risk-sharing objectives may not always be consistent and could in fact involve trade-offs, for example between efficiency and equity.

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2. It would also be possible to look at consequences of macroeconomic shocks for corporations. This approach, however, is not pursued in the present analysis which focuses on the consequences of macroeconomic shocks for individuals as they are the ultimate bearers of risk.

3. Institutions shape the primary risk-sharing across agents, as well as the availability of public and private protection, which in turn determine the final outcomes. Institutions are important for private insurance provision insofar as well-functioning insurance markets require, for example, clearly defined property rights and well-functioning legal systems.

4. While policy responses are not institutions *per se*, they are shaped by institutions.

3. Macroeconomic risk sharing has two fundamental nested dimensions. The first dimension – referred to as *international collective risk-sharing mechanisms* – concerns the possibilities for a country as a whole to insure against, or to spread the impact of macroeconomic shocks. Such possibilities are typically limited, leading to the second dimension of how to share the remaining risk within the country. Of particular relevance in this respect may be the possibility for individuals to be sheltered from particularly bad outcomes, through either private or public institutions that effectively provide protection. This second dimension is referred to as *risk-sharing mechanisms for individuals within countries*. In addition to the mechanisms for risk sharing across the relevant entities, both countries and individuals may also be able to use inter-temporal risk-mitigation devices, such as *e.g.* saving and borrowing to smooth consumption. While the paper is ultimately interested in the distribution of risk borne by individuals or households, this must also be seen in a context of mitigation of aggregate macroeconomic risk. Mitigating aggregate risk and achieving a given distribution of risk may involve some tension, *e.g.* institutions associated with a flexible labour market may mitigate aggregate risk while increasing individual risk, at least for certain groups of workers.

4. The paper is structured in the following way. Section 1 discusses mechanisms to share macroeconomic risk among countries, starting with possibilities for international insurance before looking at shock-spreading and risk-mitigating policies. Section 2 turns to risk-sharing mechanisms for individuals within a society. It assesses the possibilities for individuals to protect their wealth, labour and capital income against various forms of macroeconomic risk, and discusses the boundaries between private and government-sponsored risk-sharing institutions. It also examines possible normative criteria for the sharing of macroeconomic risk. On this basis, some policy recommendations are provided for improving individual risk-sharing mechanisms and, more broadly, for achieving more desirable risk-sharing outcomes. Section 3 presents positive evidence, both empirical and model-based, about the typical short- and medium-term distributional implications of selected macroeconomic shocks on different groups of agents,⁵ and on how such distributional implications are shaped by the institutional set-up.^{6,7}

5. The main findings fall in three parts, related to international collective risk sharing, risk sharing for individuals within countries and evidence on the distributional implications of macroeconomic shocks.

International collective risk-sharing mechanisms

- International collective risk-sharing mechanisms are not well developed. This is reflected *e.g.* in recent proposals to discuss new multilateral insurance schemes in the G20 context, such as an increase in contingent liquidity support to reduce a perceived need for reserve accumulation. Even though multilateral insurance is complicated by risks of moral hazard there may indeed be room for developing such mechanisms, but these issues go beyond the scope of this paper. International risk-sharing could also be improved by a more widespread use of sovereign bonds

5. The paper focuses on shock-driven short- and medium-term changes in outcomes such as income distribution, abstracting from any analysis of the steady-state drivers of these outcomes.

6. Throughout the paper the term “insurance” is at times employed in a broad sense. Its use is not necessarily restricted to proper insurance contracts, but occasionally refers also to institutions or mechanisms that *de facto* provide insurance-like protection in the case of macroeconomic shocks, as for example hedging possibilities, contingent liquidity or loan provision, or government-provided support.

7. It should be stressed that throughout the paper, macroeconomic shocks are thought of as large, not purely business-cycle driven changes in macroeconomic variables that affect aggregate income or consumption. Also, as consumption data are unavailable at a sufficiently disaggregated level over long time periods, the distributional impact of shocks is measured by looking at their income, wealth or labour market effects. This leaves aside any distributional effects of shocks via changes in the relative prices of the consumption baskets of different population groups.

with payoff structures related to economic growth or the occurrence of certain events (e.g. commodity price shocks or natural disasters),⁸ as well as by better developed frameworks for sovereign-debt restructuring.

- Some economic framework conditions may contribute to mitigate shocks and help spread costs internationally:
 - Policies conducive to international risk spreading include trade openness, exchange-rate or more generally real wage flexibility, international labour mobility, openness to FDI, having domestic (rather than foreign) currency denominated debt, and in some cases stabilisation or sovereign wealth funds. The empirical analysis confirms that exchange-rate, commodity-price, fiscal, and financial-crisis shocks are indeed partially exported, as reflected in significant changes in the current account in their aftermath. While in most instances macroeconomic risk spreading is a stabilising feature as it allows countries to pass part of the burden of a domestic economic shock on to others, it may contribute to global crises when shocks originate in the largest economies, calling for particular efforts in shock prevention by these countries.
 - Policies with a short-term shock-mitigating effect include macroeconomic frameworks that allow for countercyclical policy responses, primarily a sound and prudent fiscal stance and credible stability-oriented monetary policy. In certain situations, access to international reserves, through either direct holdings or international facilities such as IMF-provided flexible credit lines (FCLs), can also avert exchange-rate overshooting. Insofar as excessive movements in some types of capital flows may increase the risk of currency and financial crises, constraints on those flows could – in spite of possible economic efficiency costs – have positive effects from a risk-management perspective. Structural policies that allow for swift adjustment in prices and wages should contribute to shock-mitigation in the medium term, although they might amplify short-term fluctuations.

Risk-sharing mechanisms for individuals within countries

- Private mechanisms to insure wage income against job loss (or against a broader range of risks) are largely non-existent,⁹ and moral hazard limits the scope for progress. In this context, government-sponsored unemployment insurance and social benefit systems appear to be the essential providers of protection against wage-income loss. In contrast, asset-derived income or wealth can to some degree be hedged in private markets. Agents' abilities to exploit these possibilities differ significantly, however, often increasing with financial sophistication or wealth levels.
- While insurance remains the typical private way of risk sharing, imperfections in private insurance markets exist particularly in areas where loss payments are rare but potentially large (e.g. disaster or terrorist insurance). Regulatory reform that would strengthen incentives to build up large capital buffers in the insurance and re-insurance sector and improve re-insurers' access to additional capital in situations of large insurance-related payouts could – at some cost – considerably widen the scope of risks covered by private re-insurance, and hence by private insurance. Encouraging the issuance of disaster bonds by re-insurers would create an important

8. International risk sharing would be furthered to the degree that these instruments are held by foreigners.

9. An exception is payment protection insurance (PPI) which covers mortgage and other credit-related payments in case of job/income loss.

mechanism to generate pools of dedicated capital that would become available in situations of large payouts.

- For some extremely rare but potentially exceptionally costly risks (*e.g.* a major nuclear accident) implicit public insurance may be the only realistic solution. In many cases, however, where some element of public insurance is needed, or cannot be credibly dropped due *e.g.* to political economy reasons, it may be preferable to make implicit public insurance explicit. In addition to increasing transparency this may curb risk-taking behaviour and would allow governments to collect some insurance premiums.
- Preferences on how to split the costs of adverse macroeconomic shocks are likely to differ across countries due to a number of tradeoffs. Fairness and/or efficiency would suggest that those who either benefit most or aggravate the risk *ex ante* (*i.e.* as long as no shock materialises) should bear a larger share of the costs. However, due to inevitably limited liabilities, in most instances it would also be necessary to take a stance as to how the remaining risk should be distributed across the population, in particular along the income distribution. Considerations of fairness or desirable distributional outcomes then have to be weighed against efficiency concerns related to the economic cost of redistributive mechanisms.

Distributional implications of shocks

6. Against the background of imperfect insurance possibilities, households within OECD countries have been widely, and differently, exposed to macroeconomic shocks over recent decades, and these shocks have therefore often affected the distributions of income and wealth. Cross-country time-series empirical analysis of the distributional impacts of past macroeconomic shocks suggests the following selected regularities:

- In general, individuals on lower incomes are found to have been more strongly affected by shocks than other income groups, suffering more from adverse shocks, but at the same time often benefiting more from positive ones.
- Financial crises have tended to affect the incomes of high-income households most strongly, while the middle class has tended to improve its relative (but not absolute) income position. Lower-income households also seem to lose out particularly strongly from a financial crisis, as evidenced by rising (relative) poverty rates.
- The effect of macroeconomic shocks varies also across age groups. Labour market performance of young people has been particularly poor in the wake of almost any negative macroeconomic shock. Older households have been disproportionately affected by large changes in the fiscal stance. Past fiscal expansions have typically improved the income share of pensioners' *vis-à-vis* workers, while fiscal consolidations have led to above-average employment declines for older workers.
- Macroeconomic shocks also affect the wealth distribution through their impact on asset prices. In particular, financial crises have often been associated with house price declines. Highly-leveraged households, and those whose asset portfolios primarily consist of housing assets, are most vulnerable in such cases. The analysis suggests that 26-35 year olds tend to be the most leveraged age group, while leverage tends to decrease gradually after the age of 35. Similarly, households with net debt and households that own a dwelling, two groups with considerable overlap, are generally more affected by shocks that lead to significant house price declines, due to both higher leverage and the composition of their asset portfolios.

The influence of institutions on the distributional implications of shocks

7. Different institutional settings across countries appear to shape the distributional impact of macroeconomic shocks. The analysis of these interactions suggests the following selected results:

- Lowering high tax wedges on labour income could not only raise steady-state employment levels as shown in previous OECD (and other) work,¹⁰ but also mitigate the deterioration in employment and unemployment levels of groups with weaker attachments to the labour market, such as young or older workers, in the wake of certain negative macroeconomic shocks. Temporary, possibly targeted, reductions in tax wedges in bad times may also be effective in lowering post-shock employment declines for weaker groups.
- Generous unemployment benefits, and in particular high initial replacement rates, play a role in dampening the negative impact of macroeconomic shocks on poorer segments of society. For countries with low replacement rates, this could point to social benefits from temporarily increasing them in the wake of financial crises. At the same time, the empirical analysis points to a risk of adverse employment effects for certain groups (particularly young or older workers), possibly via their effect on search incentives or the wage-bargaining process. Furthermore, existing literature – including previous OECD evidence – points to detrimental effects of high and long lasting unemployment benefits on employment in the long run, unless effective activation strategies for the unemployed are in place.
- Stricter job protection is found to have provided some income protection for lower and middle classes in the wake of negative shocks. At the same time, it has improved the labour market performance of workers with long job tenure (older workers) *vis a vis* those with shorter tenure or entering the job market (young people).¹¹
- Minimum wages may in some instances have had beneficial income effects for less well-off (see also OECD 2011a), but this has come at the price of increased youth unemployment. The empirical analysis finds that both the level and – especially – the reach of statutory minimum wages have had adverse effects on youth employment and unemployment in the wake of numerous shocks. Group-specific minimum wages for youths would be one example of a policy device that could help young people to weather bad times.¹²
- Stronger labour unions have played an important cushioning function for lower incomes in the wake of certain shocks. Stronger union power also typically improves the labour market performance of prime-age groups in the aftermath of shocks at the cost of greater youth unemployment, consistent with insider-outsider type mechanisms. More centralised wage bargaining appears to have dampened redistribution from higher to lower income groups during fiscal expansions. This could reflect unions better accounting for macroeconomic developments under more centralised collective wage-setting mechanisms, *e.g.* moderating wage demands to achieve greater employment impact of stimulus.
- Stricter product market regulation is found to have particularly negative effects for young people and the poorer segments of society in the wake of macroeconomic shocks. Lowering PMR would therefore appear to deliver more equitable risk sharing, over and above the positive effects on

10. See *e.g.* De Serres et al. (2011).

11. Both unemployment and employment levels of youths have been negatively affected.

12. Alternatively, similar effects could be achieved by lowering tax wedges for youths.

steady-state output and employment levels identified in existing literature – including previous OECD work.

- Capital account openness may amplify regressive distributional effects in certain instances. In contrast, economic openness does not only provide international insurance by partially exporting country-specific shocks, but FDI and trade openness also appear to mitigate adverse effects on weaker groups in society, such as the young or the poor. This confirms the importance of trade and FDI openness for shock mitigation, even though openness may also facilitate contagion in the specific circumstances of a global shock or a shock affecting a large economy.
- Based on both the empirical and the DSGE analyses, financial development seems to amplify the redistributive effects of various shocks. This arises mainly as financial market sophistication amplifies credit cycles, thereby underlining the need for policies that counteract such boom-bust episodes. This further strengthens the case for strong macro-prudential regulation especially in countries with sophisticated financial sectors.
- Wealth effects from negative macroeconomic shocks are particularly large when households are more leveraged. While in theory households would choose their level of leverage to be optimal, in practice many individuals may not always be fully aware of the amount of risk they are taking. Since the recent crisis has confirmed that excessive risk taking often has negative external effects, regulation that prevents excessive leverage – including for house purchases – seems warranted and incidentally dampens the distributive effects of shocks.
- Two broad types of institutional set-ups can be identified that facilitate the sharing of income risk, namely “social protection” and “reallocation-facilitating” institutions. Social-protection institutions include unemployment benefits, job protection, minimum wages or strong unions, whereas pro-competitive product market regulation and low tax wedges are examples of institutions that contribute to risk sharing by facilitating the reallocation of resources and workers. On this basis, four broad groups of countries can be identified:
 - i) countries that provide income risk sharing mainly via social-protection institutions, such as the large majority of continental-European countries.
 - ii) countries that rely mainly on reallocation-facilitating institutions, such as English-speaking and Asian OECD countries.
 - iii) countries where neither class of institutions are developed, typically OECD and non-OECD emerging economies.
 - iv) countries that rely strongly on both of them, mainly the Nordic countries.
- The four models are likely to differ both in their income risk-sharing capacities and concerning possible connected costs. *Short-term* income risk sharing may be relatively less developed in most English-speaking and Asian OECD countries. In contrast, most continental-European and (possibly to a lesser degree) eastern-European countries are likely to pay a higher degree of income protection of lower income households in the wake of negative shocks with poor labour market performance of youth and labour market outsiders more broadly. With neither class of risk-sharing institutions being well developed in OECD and non-OECD emerging economies, households are largely left with trying to share income risk through families and other social networks and, possibly, increased participation in the informal sector. Finally, the Nordic countries, which typically combine strong reallocation-facilitating institutions with well-developed social insurance, should provide a relatively high degree of (relative) income protection to lower-income households in the wake of adverse macroeconomic shocks, even

though likely with adverse employment effects on young people. Potential problems from youth unemployment seem to have been traditionally mitigated by generous financing for education and low requirements to qualify for unemployment benefits in Nordic countries. In turn, disincentive effects may have been limited by strong activation policies and social ethics. At the same time, such a “model” probably comes with efficiency losses associated with the high costs of the benefit systems and activation policies and high marginal tax rates on the financing side, highlighting again possible trade-offs between efficiency and risk-sharing (defined here as income distribution) considerations.

- Some policies and institutions are beneficial from both a risk-sharing and an efficiency perspective, thereby providing obvious directions for reforms. Examples are short-time working schemes, relatively liberal product market regulation, and prudent fiscal policy.¹³

13 . Prudent fiscal policy provides scope for mitigation during bad times and provides stability and low interest rates in general.

1. INTERNATIONAL COLLECTIVE RISK-SHARING MECHANISMS

8. Institutions and macroeconomic policies can protect a country against macroeconomic shocks in two ways. They can either *ex ante* influence the likelihood or potential amplitude of shocks or they can *ex post* shape their consequences. Abstracting from shock-prevention policies and institutions,¹⁴ this section examines to what degree shock-induced costs can be insured or spread internationally, and how far they can be mitigated by domestic policies. While in some instances a country may be able to fully insure against a temporary shock, most temporary and all permanent shocks will leave costs which have to be spread among the population of the affected country, an issue that will be examined in Section 2.¹⁵

9. The need or incentives to insure are likely to differ across countries, reflecting different degrees of vulnerability to specific shocks. For example, as regards countries' structural features, small economies are typically more vulnerable to a broad range of shocks due to their greater specialisation also implying greater openness to trade and capital flows. While having an own currency also provides an instrument of adjustment, it makes small economies particularly vulnerable to exchange-rate shocks,¹⁶ and consequently increases the risk of large inflation shocks and real interest-rate swings. With respect to policies, countries with underdeveloped prudential regulation or insufficient lender-of-last-resort capacities (*e.g.* Iceland during the recent crisis) are more prone to financial crises,¹⁷ as are countries with overly large current account deficits and currency or maturity mismatches in their debt structure.¹⁸

1.1 Possibilities for sovereigns to take out international insurance

10. Imperfect international contract enforcement or asymmetric information, and resulting problems of moral hazard, limit the scope for sovereign governments to take out international insurance for their country.¹⁹ The potential severity of moral hazard is also reflected in the existence and set-up of the few existing international risk-sharing institutions. For example, IMF-provided protection against economic collapse triggered by balance-of-payments and/or fiscal problems is typically limited in size and comes with strict conditions attached. One exception is the Flexible Credit Line (FCL) which comes only with

14. Shock-prevention institutions and macroeconomic policies are beyond the scope of this paper, but they have to some degree been examined in Sutherland *et al.* (2010) as well as in Duval and Vogel (2008). A number of policies that are useful once a shock hits are also valuable in preventing shocks, with foreign-currency reserves being such an example.

15. Individual international risk-sharing possibilities, which will be discussed in the context of Section 2, can have collective ramifications. Investment abroad of individual pension savings or individual purchases of disaster bonds would be examples in this context.

16. Changes in financial-market mood will lead to larger swings in thinner markets.

17. See Ahrend *et al.* (2009).

18. Similarly, fiscally more virtuous and/or less indebted countries are more able to use stabilising fiscal policies, countries with better-anchored inflation expectations are less likely to experience inflation shocks, and countries with lower and less volatile inflation are less likely to experience interest-rate shocks.

19. International contract enforcement may be of lesser relevance for sovereign governments' possibilities to take out *private* insurance, but an additional constraint may be the size of the risks that private markets are willing to cover.

qualifying restrictions that are supposed to curb the risk of shocks occurring.²⁰ An increase in contingent liquidity support for developing countries to reduce a perceived need for reserve accumulation, as currently discussed, could enhance both depth and coverage of this type of international insurance provision. Another risk-sharing mechanism is the possibility for countries to restructure their debt under adverse circumstances. However, not least for fear that attempts to improve the framework might exacerbate moral hazard, the institutions and rules that govern such events remain poorly developed, generally increasing the costs for all parties. Moral-hazard issues have also been at the forefront of the discussions about the European Stability Mechanism (ESM), which is currently being developed for euro-area member countries.

11. International risk sharing possibilities for sovereign governments remain poorly developed even in areas where moral hazard should not be a large concern.²¹ For example, attempts to provide international government-sponsored insurance against accidents in the civil use of nuclear energy have, so far, progressed only slowly.²² Finally, wider use of sovereign bonds with payoff structures related to the occurrence of certain events (*e.g.* commodity price shocks or natural disasters) or certain macroeconomic variables (*e.g.* GDP) could significantly improve international risk sharing to the degree that they are held by foreigners (for a detailed discussion of indexed securities, see Box 1). Such mechanisms could be structured to minimise moral hazard risk and should be particularly relevant for economies more exposed to risk, such as countries with a more concentrated trade specialisation (*e.g.* “commodity exporters”) or an elevated risk of natural disasters. Albeit, the use of “catastrophe” bonds remains limited, possibly due to the difficulty for investors and issuers to assess disaster risk.

Box 1. GDP-indexed bonds and other indexed securities

Debt crises impose large costs not only on the defaulting country and its creditors, but also more widely on other borrowing countries and financial markets. This has led to growing interest in financial instruments that would contribute to less crisis-prone liability structures, such as bonds that are in some way contingent on macroeconomic developments.¹ One example is GDP-indexed bonds which typically link the size of interest payments to the issuing country's rate of economic growth. Payoff-structures of GDP-indexed bonds need not be symmetric, but as a simple example a country may issue a GDP-indexed bond that promises to pay *x*% below (above) the usual borrowing rate for every percentage point its GDP growth rate is below (above) a certain “normal” growth rate in a given year. To be able to issue such bonds, the country will have to pay an “insurance premium” and may need to offer a floor beyond which the coupon cannot fall. There have been suggestions for similar instruments indexed to a variety of other risk factors like terms of trade, commodity prices, or export performance.²

GDP-indexed bonds can reduce the likelihood of debt crises by acting as automatic stabilisers against pro-cyclical spending.³ When countries are hit by a negative macroeconomic shock, the lower interest payments reduce the need for fiscal adjustment or additional external borrowing, which could be particularly costly or more difficult in adverse economic circumstances. This may be especially relevant for developing countries, which have typically

-
20. *Ad hoc* exchange-rate swaps agreements between Central Banks during the recent crises could also be considered as an effective multilateral insurance mechanism against certain forms of liquidity risks. A more systematic development of such crises facilities may therefore be desirable.
21. This is also confirmed by a strand of literature that looks at the observed degree of risk sharing, typically by examining the relation between countries' consumption (or output) growth or volatility with corresponding variables for the rest of the world (see *e.g.* Kose *et al.*, 2007, and references cited therein). The main conclusion of this literature is that the degree of observed risk sharing is rather limited, and whether risk-sharing has improved with globalisation remains disputed.
22. Progress has been slow even though intended coverage would be fairly limited. The Convention on Supplementary Compensation for Nuclear Damage would provide additional international insurance to cover up to 300 Million SDRs of costs from a nuclear accident in the production of nuclear energy. While the convention was approved in 1997, it is not yet operational as it has been ratified by only four countries (with a minimum of five required). Private insurance for nuclear reactors exists but is typically limited, with governments usually explicitly or implicitly covering the remaining risk.

suffered more from worsening investor sentiment during downturns.⁴ Investors should benefit from GDP-indexed bonds through the decreased default risk, with the attendant reduction in capital losses and costly litigation and/or renegotiation procedures. GDP-indexed bonds also allow investors to take positions on countries' future growth prospects.⁵

GDP-indexed bonds possess, however, some features that may reduce their attractiveness for issuers or investors. For lenders, the absence of a liquid secondary market for GDP-indexed bonds may be problematic. Such markets are unlikely to emerge unless a number of countries were to offer sufficiently large amounts of such instruments at the same time, which may call for some form of international coordination. Also, bonds with an uncertain payout will no longer be a fixed-income asset that typically gains in value in economic downturns, potentially reducing the interest (or ability) of certain investor groups to own such instruments. Investors may also be concerned about some forms of moral hazard, such as governments tampering with GDP statistics in order to reduce their interest payments. However, because of the political costs of bad growth performance, the risk of governments consciously understating economic performance may be contained – if anything, examples of misreporting would appear to be limited to overstating GDP growth.⁶ Accuracy of data may be a more relevant problem as economic growth figures are revised frequently and for a long time, even though any systematic bias could be reflected in the price of the bonds. For borrowers, paying an insurance premium (*i.e.* higher interest rates) during periods of strong growth could be seen as politically unattractive, especially so as benefits of the insurance may accrue to future governments.

Other types of financial instruments that, although rarely used in practice, would be potentially useful for shock mitigation are bonds indexed to commodity prices or a country's export performance (see *e.g.* Krugman, 1988). Indexing debt to commodity prices would be particularly useful for countries with large exposure to commodity price shocks. The value of exports is an indicator of the ability of a country to meet its foreign obligations, and especially for developing countries data on exports may be more reliable than early GDP estimates. It should be noted that not all types of indexed bonds provide insurance to the issuer, as some categories, notably inflation-indexed bonds, have insurance features that profit the buyer.

In practice, issuance of indexed securities has been limited (see table below) and usually accounts for only a small share of issued debt. Even inflation-indexed bonds, by far the most popular indexed bonds, have only been issued by a small group of sovereigns. Issuance of GDP-indexed bonds has so far largely been restricted to situations of debt restructuring and/or financial crises. Bosnia and Herzegovina, Bulgaria and Costa Rica issued them as part of a deal installing a currency and monitoring board following a financial crisis in the late 1990s. Interestingly, Bulgaria issued bonds with a callable option and recalled them once the crisis had passed. Argentinean GDP-indexed bond issuance was part of the restructuring plan after the default in 2001. These bonds appear to have been traded over the counter and no volumes or prices are recorded.

Issuance of indexed government securities (not including inflation-indexed bonds)

Country	Date issues	Indexation clause	
Argentina	2002	GDP	GDP-indexed payments are granted to the investors as part of debt restructuring
Bosnia and Herzegovina	1990s	GDP	Issued as part of Brady Plan
Bulgaria	1990s	GDP	Issued as part of Brady Plan
Costa Rica	1990s	GDP	Issued as part of Brady Plan
France	1973	Gold	Debt servicing cost increased from depreciation of French franc against gold
France	1970s	Oil	Issued as petro-bonds
Mexico	1990s	Oil	Issued as part of Brady Plan
Venezuela	1990s	Oil	Issued as part of Brady Plan

Source: Durdu (2009).

1. See for example Shiller (1993; 2005), Borenstein and Mauro (2004), or Griffith-Jones and Sharma (2006).
2. See Krugman (1988) or Barone and Masera (1997).
3. Detragiache and Spilimbergo (2001) find that a rise in the debt/GDP ratio by 10% is associated with a 20% increase in the probability of a crisis. Easterly (2001) shows that the growth slowdown in the mid-80s significantly contributed to the increase in debt rescheduling during the following 15 years.
4. Calvo (2003) argues that for developing countries possibilities for using debt for inter-temporal consumption smoothing are

strongly limited as they often have to tighten fiscal policies in downturns to maintain access to international financial markets. Similarly, Gavin and Perotti (1997) report that public spending is particularly pro-cyclical in developing countries. By alleviating the need for borrowing in periods where interest rates are likely to be high, GDP-indexed bonds also contribute to improved debt dynamics.

5. To some extent such positions are already possible through equities and stock-market indexes, even if these do not represent the performance of the economy as a whole.
6. Furthermore, for inflation-indexed bonds both the political and financial incentives would be to understate inflation, but investors do not appear to be too concerned about moral hazard with such instruments.

1.2 Other risk-sharing mechanisms for sovereigns

12. The limited scope for international insurance calls for economic framework conditions that help spread costs internationally and/or mitigate the impact of shocks. Risk spreading and risk mitigation are, in turn, discussed in the following.

1.2.1 Risk-spreading policies and institutions for sovereigns

13. Risk-spreading mechanisms would be expected to work best in the case of shocks specific to individual countries, but may provide only limited help in the case of global crises. Real exchange-rate flexibility, trade openness, openness to *long-term* capital flows and FDI, and international labour mobility can all contribute to spread the impact of a negative shock internationally.²³ Possible shock-mitigating mechanisms also include, *inter alia*, domestic- (rather than foreign-) currency denominated debt,²⁴ or stabilisation funds that typically hold wealth in foreign-currency denominated assets to provide some protection from commodity-price or terms-of-trade shocks.²⁵ Sovereign wealth funds, though usually pursuing different objectives, are functionally similar in this context.

14. While some risk-spreading mechanisms that rely on an appropriate sovereign balance sheet work through its passive side (for example the issuing of specific types of assets to foreigners), most options consist in holding specific foreign assets. Such possibilities increase with the amount of sovereign savings, implying for instance that Norway (which holds substantial assets in an oil fund) has increased possibilities for international risk sharing. In practice, however, countries with substantial accumulated wealth are most of the time commodity exporters. Therefore, their better-developed insurance possibilities typically come with particularly strong exposure to some types of macroeconomic shocks. Whether this exposure outweighs their enhanced insurance possibilities will largely depend on the size of the wealth buffers that these countries were able to accumulate from past exports. The accumulation of large foreign asset holdings by countries, such as China, that are not commodity exporters also increases their potential for international risk sharing. However, large foreign asset positions may come at a high cost for countries that are likely to undergo substantial real appreciation over time.

23. In contrast, attempts to keep exchange rates from adjusting to their equilibrium levels are not helpful for international risk sharing.

24. It could, however, also be argued that a combination of initially cheaper foreign-currency debt with the possibility of default in adverse circumstances would be preferable as long as the long-term costs of defaulting are sufficiently low.

25. Other possibilities for countries to hedge against macroeconomic risks include the issuance of debt in domestic currency to *foreigners*, which partially protects against exchange-rate shocks. If such debt is long-term and fixed-rate it may also provide partial insurance against wealth and income losses from inflation shocks. International solidarity as often observed in the wake of disasters – even though of rather unpredictable magnitude – also constitutes effective risk-sharing. However, when aid flows are large relative to the GDP of the receiving country and impede on exchange-rate adjustment, the risk-spreading effects from exchange-rate flexibility and trade openness may be diminished. Finally, if remittances from abroad are substantial they can also contribute to absorbing shocks.

15. Membership in a monetary union (or the unilateral adoption of a foreign currency) may significantly decrease the vulnerability of a country to a large array of shocks, especially for small open economies. This comes, however, at the price of reduced possibilities for shock-mitigating policies (see Box 2). Therefore, if *ex ante* reductions in vulnerability are offset by *e.g.* relaxed fiscal discipline, countries' vulnerability may increase rather than decline *ex post*.

Box 2. Risk sharing in monetary unions

Membership in a monetary union has complex effects on a country's vulnerability to certain shocks, and hence on its need for international risk-sharing mechanisms. With the risk of exchange-rate shocks largely eliminated, a feature especially important for smaller economies, countries are less at risk of large interest-rate swings insofar as those are concomitant with, or driven by, exchange-rate shocks. Also, a country retains the possibility to restructure its debt in adverse circumstances within a currency union, even though it may be complicated by greater integration of private financial sectors. Countries in a currency union are also less at risk that given external or fiscal imbalances lead to financial crises. Put differently, lower vulnerability within a currency union allows countries to delay adjustments as they can build up larger fiscal and current account deficits before triggering strong financial market reactions. Finally, countries in a currency union are less vulnerable to financial crises insofar as these result from exchange-rate overvaluation and ensuing devaluation, currency mismatch in a country's debt structure, or from insufficient lender-of-last-resort capacity (*e.g.* Iceland suffered from such a lack in the recent crisis).

Countries in a currency union, however, are more vulnerable insofar as the common monetary policy may cause or amplify boom-bust cycles in asset prices that may end in financial turmoil (see *e.g.* Ahrend *et al.*, 2008 or OECD, 2010b). Also, there may be transition risk in young monetary unions where some members may experience rapid declines in domestic interest rates in a short period of time during the initial (nominal) interest rate convergence process. Membership in a monetary union largely foils possibilities for shock mitigation through monetary policy. As nominal exchange-rate adjustments become impossible, the possibility to spread shocks through rapid changes in relative competitiveness becomes also strongly impaired.¹ While gains in competitiveness through nominal wage cuts remain possible, they are often difficult and slower to achieve. The reduced scope for mitigation policies is to some degree offset by closer economic ties within the union, such as increased trade and stronger factor mobility (see *e.g.* Baldwin *et al.*, 2008), which should have a stabilising function when an individual member country is hit by a shock.

All in all, while membership in a monetary union strongly reduces or eliminates certain types of macroeconomic shocks, it also impedes the reaction and adjustment capacity of a country. With some channels of shock remediation being closed, developing the remaining ones gains in importance, especially so when the monetary union does not come with a fiscal union. In essence this means promoting price and real wage flexibility and factor mobility within the union. It may also be useful to prepare public opinion for the possible need for nominal wage cuts in times of crises, as this can be a condition for real wage flexibility, and to define more clearly circumstances and rules for sovereign debt restructuring. Less developed shock-mitigating policies also call for stronger shock-prevention policies, such as sound fiscal policy and more stringent micro- and macro-prudential regulation. Finally, some type of intra-zone insurance mechanism may be envisaged, but must be carefully designed to minimise moral hazard.

1. In this respect, union-wide higher inflation targets may actually make it easier for a distressed country to regain lost competitiveness vis-à-vis the other union members, and could therefore be seen as a kind of insurance device. All else equal, optimal inflation rates may therefore be slightly higher for members of a monetary union, but potential benefits from such insurance would have to be weighed against possible costs from higher average inflation. Such considerations would be more relevant during the set-up period of a monetary union, as the potential cost from changing existing, credible inflation targets may easily outweigh possible insurance-related benefits.

16. The empirical analysis confirms that commodity-price, fiscal, and financial-crisis shocks are indeed partially exported, as reflected in significant changes in the current account in their aftermath (see Section 3).²⁶ While such international risk-spreading mechanisms are generally desirable, they may at

26. On a somewhat related point, Flood *et al.* (2009) provide evidence that financial globalisation has improved international risk sharing, as measured by the variance of a country's share in per capita world consumption. Following this measure globalisation has led to only little improvement in risk sharing at the business-cycle frequency, but risk-sharing gains have been widespread and large at lower frequencies. The finding that financial globalisation has improved risk sharing remains disputed, however.

times be seen less benevolently by countries to which part of the costs are exported. Whether contagion is a problem depends on the size of other countries and on the ability of their macroeconomic policies to minimise the impact of shock-spreading.²⁷ The international spreading of shocks originating from small economies does not, in general, cause severe damage unless the shocks trigger financial market panic. In contrast, shocks that hit the largest economies can have more significant adverse international consequences. For example, the international spreading of risk *via* securitisation contributed to transforming the US sub-prime problem into a global crisis, highlighting the global benefits from greater shock-prevention efforts by the largest economies.

17. Tensions can also arise when acquisition of protection by a country either prevents other countries from doing so or has the potential to harm them in other ways. For example, recent FDI activity by state-controlled companies of some countries has been interpreted as reflecting the view that ownership of companies that hold the exploitation rights to certain raw materials would be an important ingredient of supply security. While purchasing commodity-price related assets can be seen as protection against commodity-price shocks for a commodity importer, large-scale purchases of scarce resource exploitation rights *via* state-owned or state-dominated companies can exert a negative externality on other countries' supply security by reducing the size of the spot markets, and thereby increasing price volatility.²⁸ Export restrictions on agricultural goods, for example, can have similar negative externalities.

1.2.2 Shock-mitigating domestic and international institutions

18. Policies and institutions with a short-term shock-mitigating effect – and which constitute to some extent inter-temporal risk-mitigation devices – include macroeconomic frameworks that allow for counter-cyclical policy responses. Low debt and deficit levels combined with a reputation of fiscal rectitude allow countries to maintain their ability to borrow at acceptable rates in times of crisis and hence to better smooth the impact of temporary shocks. The same holds for the capacity to pursue strongly accommodating monetary policies under credible monetary policy regimes that anchor inflation expectations at low levels.²⁹ Macro-prudential regulation may constitute an additional lever for countercyclical policy, especially when monetary policy may not be able to play this role (*e.g.* in monetary unions).³⁰ Structural policies that allow for swift adjustment in prices and wages should contribute to the mitigation of aggregate shocks in the medium term, although they might amplify short-term fluctuations and exposure of individuals. For example, strong regulation in labour and product markets has been found to dampen the initial impact of shocks, but at the cost of making their effect more persistent.³¹ Many continental-European economies are characterised by relatively stringent labour- and product market regulation,

27. Efforts by countries less affected by the recent financial crisis to prevent their exchange rates from appreciating could be interpreted as attempts to counteract existing international risk-spreading mechanisms.

28. A related example where protection for some increases volatility for others is the European Common Agricultural Policy, which effectively has protected incomes of European farmers against price fluctuations at the expense of farmers in other (mostly developing) countries.

29. Compared with inflation targeting, price-level targeting may further mitigate business fluctuations in response to temporary shocks (Cournède and Moccero, 2009).

30. See *e.g.* Sutherland *et al.* (2010).

31. See *e.g.* Duval and Vogel (2008). More precisely, but also more tentatively, stronger employment protection legislation is associated with increased output-gap persistence, while product market regulation appears to dampen the initial output-gap effect of shocks.

consistent with the view that these economies are better sheltered against the initial impact of shocks but suffer more protracted recoveries compared with many English-speaking OECD countries.^{32,33}

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32. Medium-term mitigation may also be furthered by a better educated – and hence more flexible – workforce and labour market activation strategies that facilitate reemployment, as in the northern European countries.
33. While shock mitigation can itself have distributional consequences, gains from shock mitigation should in principle allow for compensating those who lose out from those policies.

2. RISK-SHARING MECHANISMS FOR INDIVIDUALS WITHIN COUNTRIES

19. This section examines existing public and private risk-sharing mechanisms across individuals and explores policy options to improve them, before turning to the fundamental question of how risk should be shared.

2.1 Existing risk-sharing or insurance mechanisms across individuals

20. Within a country, *i.e.* without the possibility to shift risk abroad, by definition not everybody can be fully protected against a macroeconomic shock.³⁴ However, macroeconomic risk can be shifted around to achieve particular distributional outcomes. Risk sharing can either be achieved through protection that arises from government-sponsored institutions, result from insurance taken out in formal insurance markets, or stem from more informal mechanisms such as solidarity within social networks (*e.g.* extended families).

21. In addition to such risk sharing, single individuals can also spread the cost of macroeconomic shocks over time by smoothing their consumption. For example, unemployment insurance provided by redistribution would fall in the risk-sharing category, while individual unemployment insurance savings accounts would fall in the consumption-smoothing category.³⁵ Possibilities for smoothing consumption over time generally increase with the completeness of financial markets. Easier access to credit improves possibilities for individuals to protect their consumption against temporary idiosyncratic shocks (including macroeconomic shocks that affect only a small part of the population) and hence in principle provides for an important inter-temporal risk-mitigation mechanism.³⁶ Recent experience indicates, however, that in situations of imperfect financial regulation increased borrowing possibilities may also be associated with the risk of a macroeconomic shock occurring in the first place.

2.1.1 Requirements for well-functioning private insurance markets

22. To allow for a full development of private insurance markets without government intervention, the distribution of risks across insured individuals should ideally be similar to that of the underlying population (no adverse selection),³⁷ and coverage should not overly influence individuals' actions (no

34. For instance, when the government takes part of the risk it shifts costs on to current or future taxpayers and risk towards holders of existing government bonds.

35. For more detailed information on unemployment insurance through personal accounts see *e.g.* Boss *et al.* (2007) and Brown *et al.* (2006).

36. While institutions that facilitate inter-temporal consumption smoothing are particularly relevant for temporary shocks, they can also be of use in the face of permanent shocks when adjustment costs are non-linear or in the presence of uncertainty about whether a shock is permanent or not.

37. Adverse selection describes a situation where – due to asymmetric information – good risks may not want to insure, leaving an insurer with a disproportionate number of bad risks (and a suspicion that all individuals asking for insurance may be bad risks). This process drives up insurance premiums and reduces or even prevents insurance coverage (see Akerlof, 1970). The solution to such market failure is to improve the collection of information and the second-best is to make insurance mandatory, although forcing agents to take out insurance also entails welfare costs. A related social problem arises when an insurer can in principle identify bad risks (*e.g.* in health insurance), but this results in some agents not being able to buy insurance coverage at affordable prices. Typical regulatory solutions in such situations are mandatory insurance with a prohibition for the insurer either to find out the relevant information, or an obligation for the insurer to accept “bad” risks at regulated premiums (possibly along with some compensation).

moral hazard).³⁸ In addition, a portfolio with a large number of similar but uncorrelated risks minimises the probability for an insurer to end up being unable to fulfil all claims. Well-functioning private insurance markets also call typically for an absence of negative externalities, as can arise when taking out insurance by some either reduces insurance possibilities for others or increases their risk of suffering the event in question. Also needed is that the probability distribution of insured events and associated losses can be estimated with a sufficient degree of precision, *i.e.* limited so-called Knightian uncertainty, and that the size of the risk remains such that it can effectively be insured privately (*e.g.* none of these conditions fully hold regarding damage from climate change or for major shocks such as the recent financial crisis).³⁹ In practice, these conditions are often violated to some degree, in which case the social desirability of insurance will depend on how agency costs compare to the social benefits from insurance.

23. The depth of private insurance markets, as measured by insurance penetration, differs markedly across OECD countries (see *e.g.* OECD Insurance Statistics). Differences in insurance-market depth likely reflect a multitude of factors, such as preferences, income levels, the general development of financial markets, regulation and the existence of government-sponsored insurance schemes. However, together with even greater international differences in market depth in the various segments of the insurance sector, they also hint at widespread possibilities for increasing the scope of private insurance provision across the OECD.

24. While in ideal conditions private insurance would be expected to be more efficient, there are additional obstacles to the functioning of private insurance markets that may favour government-sponsored insurance solutions. Government-sponsored insurance is much less exposed to the limited liability problem of commercial companies, as governments have the advantage of being able to finance insurance payment *ex post* through taxes. Public provision of insurance can also be more cost efficient, with basic health insurance being a possible example. Also, when insurance premiums would be very low, tax-financed public protection may be more cost efficient as no costs of concluding contracts and collecting premiums arise.⁴⁰

38. Moral hazard refers to a situation where having insurance changes the behaviour of the insured, in the sense of making the insured event more likely or costly. A prominent example is unemployment insurance, which may discourage unemployed individuals from actively looking for a new job. Combined with adverse selection – private unemployment insurance mainly being taken out by those most at risk of unemployment – this may drive up premiums to levels where private markets break down. Dealing with moral hazard is complex and in general only partially successful and/or costly, which may explain why in most countries instances of severe moral hazard are typically addressed by government-sponsored institutions, such as public unemployment insurance schemes.

39. Third-party vehicle insurance is a good example of an insurance market which in principle should function well and in practice usually does. An important number of car accidents with relatively small and statistically predictable losses are typically largely uncorrelated, and losses are distributed relatively smoothly over time. Consequently, as the risk that an insurer will not be able to cover losses in a given year is small, insurers need to hold only relatively limited amounts of capital to cushion against particularly bad outcomes. As third-party vehicle insurance is typically mandatory and premiums can differ as a function of the risk profile of individuals, it generally also presents no problem of adverse selection. Finally, moral hazard is contained as drivers' lives are ultimately at stake.

40. In some sectors, public insurance provision may also be more immune to lobby groups that try to push up rents for providers of insurance-paid services, which may explain the higher costs of some predominantly private health-care systems.

2.1.2 Private and public insurance possibilities and imperfections in insurance markets

25. Risk-sharing mechanisms typically differ along two dimensions, namely the type of provider (public or private) and the object of protection (wage income, capital income, or wealth).⁴¹ Box 3 examines in detail risk-sharing possibilities for a selection of macroeconomic shocks along these two dimensions.⁴² Importantly, existing protection possibilities are characterised by a general lack of private mechanisms to insure wage income against macroeconomic shocks.⁴³ Government-sponsored unemployment insurance and welfare benefits would appear to be the main pillars of risk sharing in this field, with income-based taxes also playing a role in some countries.⁴⁴ In contrast, asset-derived income or wealth can to a certain degree be hedged in private markets. Agents' capacity to hedge may, however, differ significantly, often increasing with financial education or wealth levels.⁴⁵ Taken together with a lack of private insurance for wage income, this implies that lower-income households have significantly less scope for taking out private protection against macroeconomic shocks than better-off individuals.

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41. Shocks can also be seen as differing along various dimensions. For example, they can either affect all individuals negatively (though potentially to different degrees) or they can hit only some of them with potentially quite large negative effects (and some individuals may actually gain from the shock). Oil price shocks, which affect consumption possibilities of all agents, would be examples of the first type, while natural disasters or the employment impact of sector-specific shocks would be of the second type. Consequently, policies that could be used to address the first type of shock would rather be of a redistributive nature along some normative criterion (*e.g.* income distribution, see Section 2.3), whereas for the second type of shock they would rather have an insurance character.
42. The discussion focuses on one-off events rather than on permanent changes, which are typically hard to insure and in any event require behavioural change rather than insurance (*e.g.* job loss with permanent loss of human capital ultimately requires acceptance of a lower wage and/or investment in human capital). Private risk-sharing possibilities are usually better developed for temporary shocks. For permanent shocks, financial insurance is typically limited to wealth, with protection for capital income available for limited time spans at best.
43. An exception is payment protection insurance (PPI) which covers mortgage and other credit-related payments in case of job/income loss. PPI has increased significantly in recent years. PPI is, however, a somewhat specific case as it does not provide protection for the wage income as such, but only for the part of it which is earmarked for debt servicing.
44. Beaudry and Pages (2001) argue that a large part of the cost of business cycles to households consists in individuals being laid off in recessions getting new jobs at lower wage levels, which are then fairly persistent. As this is a low-probability but high-impact risk, agents will not save enough to insure against such an event. Making unemployment insurance replacement rates cyclical (*i.e.* higher in recessions, lower in expansions), or paying wage subsidies to those finding a job in recessions would improve risk sharing and hence diminish the welfare costs of business cycles.
45. In addition, wealthier agents would typically be expected to have more diversified income sources and wealth holdings, which may provide a greater degree of protection against macroeconomic shocks.

Box 3. Private and public risk-sharing possibilities for selected macroeconomic shocks

This box looks at insurance and other risk-sharing mechanisms for the wage, income and wealth loss risks associated with a variety of macroeconomic shocks, with a summary of protection possibilities provided in the table below. The classification refers to protection possibilities that are available for protracted periods, disregarding option strategies that could in principle be implemented over shorter periods, but are likely to be prohibitively costly in the longer run. For each of the shocks under consideration, wage income is typically partially protected through some form of public unemployment insurance or social benefit provision,¹ with income-based tax systems also contributing to government-sponsored protection in some countries.

Possibilities to protect wealth and capital income in private markets are best developed for exchange-rate, commodity price and inflation shocks. For example, holding part of one's assets in foreign currency is a hedge against both wealth and capital income effects from *exchange-rate shocks*. Households in commodity-importing countries can, to some degree, hedge wealth against *commodity price shocks* by holding stocks of commodity companies. Capital income can similarly be hedged by holding assets with income streams that are positively correlated with commodity prices (e.g. commodity producing companies). Households can protect their wealth or capital income against *inflation shocks* insofar as they can hold inflation-proof assets. In contrast, wage income is typically not protected from inflation shocks, though individuals and groups with strong bargaining power may in practice be rapidly compensated for inflation. While often seen as easily leading to price-wage spirals and hence not advisable, the level of real wage income can in principle be protected against inflation-induced losses via legal wage indexation requirements.

Some possibilities to protect wealth and capital income exist also for natural disasters, as well as for interest-rate and technology shocks and, to a minor degree, financial crises. Natural disasters can be thought of as capital stock shocks and for some of them private insurance is offered on an individual basis, e.g. hurricane or flood insurance. Some form of implicit public insurance is also typically made available for large unexpected types of disasters. Assets exist whose income streams are immune to interest-rate shocks (e.g. long-term bonds, to some degree housing). Except for holding wealth in low-yielding short-term deposits, however, it is difficult (or prohibitively costly) to protect it over protracted periods against shocks to long-term interest rates as the value of most common asset classes will be adversely affected by them. Financially well-versed or wealthy individuals have nonetheless some scope for protecting their wealth from interest-rate risk through derivative contracts. Assuming that technology shocks are reflected in equilibrium interest rates, the right split of wealth between long-term bonds and stocks would allow some degree of protection of wealth against such shocks. Capital income can be protected from (negative) technology shocks by acquiring assets with fixed income streams (i.e. long-term bonds). However, as hedging wealth and capital income require different portfolio structures, it would be difficult to protect both at the same time. Holding bonds of the most solid debtors usually protects wealth in situations of increased risk aversion in financial markets, as shown by numerous recent examples of "flight to quality" during crises. Holding wealth partly in foreign assets may provide some limited protection against country-specific financial crises, though not against global ones, both for individuals' wealth and asset derived income. While credit default swaps and similar derivatives can in principle be used to hedge against (global) financial turmoil, the recent financial crisis has highlighted that the increased counterparty risk in times of financial distress strongly undermines the usefulness of such hedging strategies.

For a number of shocks, hedging possibilities are strongly limited. This, however, may reflect that these shocks either would not be expected to have a large and detectable negative impact on wealth or capital income (e.g. labour supply shocks), or that shocks are generally uninsurable (fiscal shocks) as not well suited to actuarial calculation. The impact of a positive unskilled *labour supply shock* (e.g. an immigration shock) would in general be positive for stocks and may also lead to increases in housing prices, at least temporarily. Unskilled workers could hence to some degree compensate a possible wage loss by holding such assets.

Ageing societies raise several risks against which different pension schemes provide varying degrees of protection. During the accumulation phase, individuals in private defined-contribution schemes are typically fully exposed to longevity shocks (defined as unexpectedly strong increases in longevity).² However, if individuals, for example upon retirement, buy annuities they are protected against income risk from *longevity shocks*. However, they continue to be exposed to counterparty risk, as insurance companies may go bankrupt if they themselves are not covered against longevity shocks, and remain vulnerable to the political risk of changes to the tax system. Individuals covered by public defined-benefit schemes are not in principle exposed to market or longevity risk. In practice, however, they are exposed to the political risk that the system is unexpectedly reformed to cope with ageing-related challenges. From a risk-sharing perspective, multi-pillar systems may therefore be the preferred option to hedge partially against both market and political risks.

Possibilities to protect wealth, wage and capital income against different macroeconomic shocks

(Darker shades indicate more developed possibilities)³

Shocks	Wealth		Wage income		Capital income	
	Private	Public	Private	Public	Private	Public
Natural disaster (capital stock)						
Exchange rate						
Long and short-term interest rates						
Inflation						
Technology (structural change)						
Commodity price						
Labour supply	NR	NR				
Fiscal						
Longevity	NR	NR				
Financial crisis (risk aversion)						

NR – Not relevant

1. Unemployment insurance provides partial insurance for employment shocks, while the welfare system provides partial protection for low-income individuals against large wage shocks. See also Blanchard and Tirole (2008) for a discussion of unemployment insurance.
2. It should be stressed that ageing, as such, is not a shock as it materialises gradually rather than abruptly, is largely predictable (and predicted) and has only small immediate effects. In contrast, longevity shocks (*i.e.* the discovery that life expectancy has increased more than previously projected) are unpredictable by definition, arise abruptly and have immediate effects *e.g.* on the solvency of private life insurance providers.
3. The exact shading of each cell can be challenged, and the table is simply meant to provide some basic information on the extent and form of risk-sharing possibilities for wealth and income. As income-based taxation – by definition – provides some partial protection for almost any type of shock, it is disregarded in the shading of the different cells.

26. Private risk-sharing possibilities, both through proper insurance or through hedging possibilities in financial markets, are often limited in scope or duration. Some types of contract also require the protection seeker to be able to post potentially significant amounts of collateral. Even when some individuals can fully hedge against a certain risk, lack of market depth often would not permit all individuals in a country to simultaneously do so without creating major disruption. In the extreme, an attempt by a large number of individuals to take out financial insurance against a certain risk may trigger exactly the type of event individuals were trying to protect against in the first place. For example large-scale attempts to hedge against currency devaluation may trigger such an event. Finally, scope for financial insurance is also particularly limited for wealth held in, or income from, non-listed assets (*e.g.* most SMEs, real estate).

27. Imperfections in private insurance markets exist particularly in areas where a smooth flow of annual premiums must be matched against rare but potentially large loss payments that are typically hard to evaluate actuarially (*e.g.* disaster, terrorist, or financial insurance).⁴⁶ For financial insurance, imperfections are exacerbated by the need for the insurer to post potentially large amounts of collateral, which may lead to liquidity problems and/or difficulties in adhering to regulatory norms. As shown by the example of AIG during the recent crisis, swings in financial market perceptions of credit risk can result in

46. While, pre-crisis, private financial insurance (*e.g.* credit default swaps) appeared to be a well-developed market, it has become clear that much of this “private” insurance was incomplete. However, as this incomplete insurance was provided by institutions judged to be too big or systemically important to fail, it was supplemented *de facto* with implicit public insurance.

collateral requirements that threaten the viability of the financial insurer, even though insured events have not occurred and may actually never occur. The increased bankruptcy risk from financial insurance activities may call for preventing “classic” insurance companies from writing financial insurance contracts, leaving this field for specialised entities.⁴⁷

2.1.3 Additional risk-sharing mechanisms for individuals

28. In addition to the risk-sharing mechanisms provided by governments or private insurance markets, risk sharing within households or (extended) families can also play a role. For example, (extended) families provide a mechanism for pooling imperfectly correlated individual-income risk (see e.g. Heathcote *et al.*, 2009), including through *inter-vivos* transfers and bequests. Families can also reallocate labour supply among group members in response to shocks.⁴⁸ In contrast, single adult households, and particularly those with small children, have little possibility to react to negative shocks by adjusting labour supply, and hence are particularly vulnerable, all the more so as they are often credit constrained. Child care subsidies can improve risk sharing by raising labour supply elasticities in general and those of second-earners in particular. A safety net for younger workers arises from the option to transit between living with their parents and independently (Kaplan, 2010).⁴⁹ At least in some countries, firms also provide their workers with considerable protection against transitory shocks to firm performance.⁵⁰ A particular protection device is short-time working schemes, under which workers forced into shorter hours are partially compensated by employers and/or public unemployment insurance schemes (OECD, 2010a). The part of short-time working schemes financed by the employer constitutes a private risk-sharing mechanism. Such a protection device is particularly useful to reduce loss of human capital in industries with high levels of firm and/or sector-specific skills in the face of transitory shocks. Public subsidies to short-time working schemes amount *de facto* to a transfer to these sectors from sectors with lower levels of specific human capital. The predominance of the former sectors in German industry explains in part why short-time working schemes have been in place for a long time in this country, and why firms used them extensively during the recent crisis.

29. There are also a number of institutions that – while not necessarily intended as risk-sharing mechanisms – effectively have some risk-sharing dimension. Examples are the possibility for individuals to declare bankruptcy, which can be seen as a protection mechanism against extreme losses in wealth and income. Similarly, in those jurisdictions where it exists, non-recourse loans (“jingle mail”)⁵¹ provides some protection to highly leveraged house owners against large drops in house prices.

47. See Schich (2010) for a detailed exposition of the argument, as well as Schich (2009) for additional evidence. Alternatively, when financial insurance and less risky lines of insurance (such as auto insurance and standard homeowners insurance) are located within the same holding company, this may call for the less risky lines of insurance to be sheltered from bankruptcy risks and to be able to operate on a “stand-alone” basis.

48. Attanasio *et al.* (2005) argue that the ability of spouses to adjust labour market participation decisions offers valuable protection against shocks to earnings. This holds, however, only when both individuals are not working full-time already.

49. More generally, increases in household size have also been used as a mechanism for coping with economic crises (see e.g. Frankenberg, Smith and Thomas, 2003).

50. See e.g. Guiso *et al.* (2005).

51. “Jingle mail” refers to the possibility to walk away from a mortgage without further obligations by simply handing over the keys of the mortgaged house to the loan-granting institution.

2.2 Policy options to improve existing public and private risk-sharing mechanisms

2.2.1 Addressing market failures through regulatory action or reform

30. Major imperfections in private insurance markets for events such as disasters or terrorism have often led governments to provide public re-insurance and sometimes even direct insurance coverage. This, however, may not be the most efficient policy response due to both the lack of price signals and potential government failure.⁵² Regulatory reform could strengthen incentives to build up large capital buffers in the insurance and reinsurance sector,⁵³ and facilitate re-insurers' access to additional capital when large losses need to be covered. Such reforms would considerably widen the scope of risks for which private re-insurance, and hence private insurance, could be offered (see Box 4). Fostering the issuance of disaster-linked bonds by re-insurers would also be an important mechanism in this regard. An in-depth discussion of disaster-linked bonds is beyond the scope of this paper, but can – together with detailed suggestions for fostering the development of markets for such bonds – be found in OECD (2009); OECD (2008) and OECD (2011b).

Box 4. Is catastrophe risk uninsurable?

While catastrophe risk is often considered as “uninsurable” by the private sector, theoretical considerations indicate that in many cases it could be insured. Moral hazard or adverse selection (though present) usually do not pose severe problems to private insurance provision in the context of catastrophe risk, given the absence of informational problems and the exogenous nature of many of the events. Also, while pricing catastrophe risk may be challenging, technical difficulties have historically not prevented the existence of well-developed catastrophe insurance markets as shown for example by marine insurance. Finally, even when the potential loss may be large, most types of catastrophe events are usually local and uncorrelated with a global market index, meaning that they should in principle be diversifiable in financial markets.

The current size of the reinsurance market for all types of non-life insurance (as measured by net premiums written) amounts to somewhat above USD 100 billion per year, and the global reinsurance sector's capital amounts to over USD 300 billion, of which close to USD 200 billion is in excess of regulatory minima (see International Association of Insurance Supervisors, 2008 and 2009). In comparison, yearly losses from natural disasters are estimated at USD 40-80 billion in years without particularly large disasters, but were around USD 200 billion in the year of Hurricane Katrina or the Wenchuan earthquake. These figures indicate that current global disaster reinsurance capacities are significant, but by far insufficient to provide full disaster insurance, especially since reinsurance capacity is not only dedicated to disaster insurance. An expansion of the sector to levels of activity and capital reserves that would allow insurance against the large majority of natural disasters would demand major efforts, though these are not out of reach.

Historically, markets for catastrophe risk have been underpinned by two institutional features:¹

- Bottomry was a system in which a lender advanced the full cost of ship and cargo to the ship owner as a loan. If the journey was successful the reimbursement included a substantial risk premium; if the ship was lost the loan was forgiven.
- Syndicate insurance – as practiced by Lloyds – meant that a broker insured a ship and its cargo with a syndicate of “Names”, *i.e.* rich individuals that pledged the full extent (or more recently a defined part) of their personal wealth to settle potential losses.

52. If first best solutions remain unattainable, public-private partnerships can be a relatively efficient and useful approach to financially manage terrorism risk and enhance insurance coverage (see *e.g.* OECD, 2005).

53. Increased capital buffers would obviously carry some cost that would have to be reflected in insurance premiums. However, the recent financial crisis has highlighted the critical importance of large financial buffers in difficult environments.

In both cases, the defining feature was a clearly identified pool of capital allocated to meeting high losses. The absence of markets for catastrophe risk points to a lack of possibilities or incentives for re-insurance companies to constitute sufficiently large potential reserves of capital. Such potential pools of capital could consist of: *i*) dedicated capital outside the re-insurance sector that covers losses in case of a major catastrophe; *ii*) the possibility for a re-insurance company to have automatic access to additional funds in a situation of crisis, a mechanism which is specifically relevant for financial insurance where, as mentioned earlier, collateral requirements may drive insurers into bankruptcy even without a major negative event actually occurring; and, *iii*) reserves held directly by re-insurance companies.

To generate dedicated capital outside the insurance sector, the development of markets for disaster bonds, the modern equivalent of bottomry, could be furthered. However, individuals and mutual funds would be well advised to hold only fairly limited shares of their net wealth in such bonds, and it would seem preferable to prevent banks from leveraging up on holdings of such bonds (as they did e.g. with securitised subprime loans). In light of the experience from the recent financial crisis, addressing the need for re-insurance companies to access additional funds in a situation of crisis might require lending from public entities, as in situations of large uncertainty sufficient private capital may not be available.² Finally, enhancing reserve holdings within the insurance sector would likely require substantial regulatory and accounting reform.³ This may potentially include changes to the tax law to eliminate disincentives against the build-up of reserves, changes to accounting rules to allow the build-up of earmarked reserves, and/or changes to take-over rules to prevent corporate raiders from taking over insurance companies and distributing existing reserves to shareholders with the attendant risk that the company is no longer able to honor its insurance contracts in the case of a major event.

1. See Jaffee and Russell (1996) for details.

2. See Jaffe and Russell (2009). Using the large borrowing capacity of the public sector to provide financing to re-insurance companies or other financial institutions in times of financial crisis would hence constitute a form of intertemporal risk-mitigation provided by sovereigns.

3. See Jaffee and Russell (2003) or (1996) for more detailed discussions.

31. Other imperfections in insurance markets that could at least in part be remedied by regulatory action include informational problems, as well as lack of market depth that may arise from coordination failures. Greater standardisation of some types of insurance contracts should help to overcome informational problems, and thereby to strengthen competition, reduce prices and raise individual insurance coverage. Many countries could contribute to an improved functioning of longevity-risk-related insurance markets simply by compiling and publishing up-to-date mortality information. Insurance options for longevity risk could also be improved by fostering deeper markets, possibly including through mandatory purchases of annuities from personalised pension accounts upon retirement to address adverse selection,⁵⁴ and/or improved possibilities for reverse mortgages (see Rusconi, 2008, for more detailed information on annuities markets). Likewise, longevity risk is insufficiently addressed in most private pension funds (Antolin, 2007), which typically also suffer from other macroeconomic risks.⁵⁵ Finally, risk-sharing considerations suggest that individuals should not hold large shares of their wealth in the company they work for, calling for diversification requirements to be taken into account when promoting such equity holdings through fiscal incentives.

54. It must be noted that full annuitisation of pension benefits at retirement is only optimal if households are insured against health and long-term care expenditure risks.

55. Private pensions are typically exposed to additional macroeconomic risk as there are insufficient investment possibilities that would allow for the implementation of proper risk management strategies and provide the degree of certainty on returns generally demanded by the insured (see Schich and Weth, 2006). On the related issue of whether governments should take these challenges for pension fund managers into account when deciding on their own debt issuance, see Ervin and Schich (2007). On funding regulation related aspects of risk-sharing in private pension plans, see Pugh and Yermo (2008).

2.2.2 Addressing market failures through government-sponsored schemes

32. In addition to the aforementioned role of government-sponsored institutions in the provision of wage-income protection and the large role public institutions play in health insurance in many countries, explicit public re-insurance might constitute a second-best solution when private re-insurance is not available and once possibilities to foster private re-insurance capacities have been exhausted. For some extremely rare but potentially exceptionally costly risks (*e.g.* nuclear catastrophes, sizeable meteorites), partial implicit public insurance may be unavoidable, but implicit public insurance is suboptimal in many instances. Areas where implicit public insurance has proven to be problematic include “frequent” natural disasters (*e.g.* floods), oil spills, private pensions, as well as more recently bonds of “systemically important” banks or US housing agencies. Where some element of public insurance is needed, or cannot be credibly dropped due *e.g.* to political economy reasons, moral hazard can often be mitigated by making insurance explicit (and possibly mandatory), as this allows discriminating against riskier behaviour through higher insurance premiums.^{56,57} Transforming implicit public insurance into explicit mechanisms also increases transparency and – even when some redistribution is intended – would normally allow governments to collect at least part of the expected costs from the beneficiaries of the public guarantees.

2.3 How should risk be shared?

33. The previous discussion shows that well-functioning private insurance markets and (in some cases) public devices contribute to a more efficient sharing of macroeconomic risk, and that there remains room for improving the completeness of insurance markets in several areas. However, even under well-functioning insurance markets shocks will usually have distributional effects, *e.g.* because individuals opt for different degrees of protection and/or are affected differently by the shocks. This leaves open the possibility that market-determined distributional effects from macroeconomic shocks may still be seen as undesirable from a social-welfare perspective, even in the case of perfect coverage by private insurance, providing a rationale for government interventions.⁵⁸

2.3.1 Candidate criteria for risk sharing

34. The presence of important trade-offs generally prevents a consensus among countries on optimal policy objectives, including as regards risk-sharing criteria (see Box 5 for some possible criteria).⁵⁹ Fairness would suggest that insofar as they can be identified, those who benefit most from the risk *ex ante* – *i.e.* as long as no shock materialises – and fail to take out adequate protection should bear a larger share

56. It would, for example, be preferable to have credible rules for bank bailouts, as well as specific bank bankruptcy procedures (including “living wills”).

57. In situations that are fraught with moral hazard and where prevention is especially important (*e.g.* flood insurance) there could also be a role for regional monopolies (either regulated private companies, or possibly even public entities). Such institutions would have strong incentives and scope to support prevention policies if endowed with the necessary authority (*e.g.* to participate in the elaboration of zoning restrictions). For a more detailed argumentation see von Ungern-Sternberg (2003).

58. Put differently, even with adequate private insurance instruments the achievable Pareto optima may not be socially optimal.

59. Unless the pre-shock distribution of income and wealth was perfectly in line with a given social welfare function, the question arises as to whether the costs of a shock should be shared according to the social welfare criterion, or whether losses should instead be distributed so that society moves closer to the optimal distribution that would be implied by the welfare criterion. Any theoretical foundation for how to distribute welfare losses is hence even more complex than the question of setting up a welfare criterion. Consequently, the presented candidate criteria, while often inspired by social welfare criteria, do not match them one-for-one.

of the costs. A similar argument based on both fairness and efficiency could be made for those who, as a result of moral hazard, increase the risk of a negative shock occurring. In practice, however, and as confirmed by the recent crisis, it would seem unrealistic to expect costs to be fully attributed along such criteria. This makes it necessary to take a stance as to whether and, if so, how remaining macroeconomic risk should be shared across the population, and in particular along the income distribution. This should ultimately reflect social preferences, although preventing macroeconomic shocks from deepening poverty may be warranted both on distributional grounds and because of the possible negative externalities from poverty. There may also be a case for temporarily protecting more those who have little possibility of adjusting rapidly to the shock, *e.g.* single households with young children or individuals above a certain age⁶⁰ who cannot easily change their labour supply.⁶¹ In any case, considerations of fairness or desirable distributional outcomes must be weighed against efficiency (and government failure) considerations related to changing incentive structures, conceivably with social dimensions receiving a relatively larger weight in the wake of rare, large shocks. This could also imply the desirability of *ad hoc* mechanisms in the wake of unusually large shocks.

Box 5. Candidate criteria for macroeconomic risk sharing

Without making a judgment on their desirability, possible risk-sharing principles would spread risk such that it is:

- borne by those who benefit most from the risk *ex ante* – *i.e.* as long as it does not materialise – especially if they fail to take out adequate protection.
- borne by those who may be most subject to risks of moral hazard, *i.e.* by those who by pursuing personal gain may increase the risk of a negative shock occurring.
- borne by those who are most able to protect themselves against (through financial insurance), or adjust their behaviour to the risk considered, *e.g.* by increasing labour supply.
- allocated based on one or several of the following social welfare criteria:
 - not be borne by those who are already or would fall below a certain minimum living standard, which could be seen as being similar in spirit to a Rawlsian welfare criterion.
 - be borne by those whose utility would be less affected, *i.e.* a so-called utilitarian criterion. Assuming that utility from additional income is decreasing with income levels, this would imply that the better-off assume a larger part of the risk.
 - distributed such that the income distribution, assumed to be in line with societal preferences, is not altered, *i.e.* a revealed social preferences approach.
 - take future welfare into account, which in practice may call for impacts on R&D or human capital to be minimised. Following such logic, it may also be undesirable that innovative start-ups in high-growth areas fall victim to macroeconomic shocks.

2.3.2 The political economy of risk sharing

35. Even if there was a consensus about optimal risk-sharing criteria, risk-sharing outcomes may well be substantially different. Political economy considerations suggest that powerful and politically well-represented groups may escape bearing an adequate amount of risk *ex post*. Examples may include, *inter alia*, the financial sector, large voting groups (*e.g.* baby boomers) or labour market “insiders” on heavily

60. Not to be confounded with retired individuals in their sixties (or below) and in good health who – unless prevented by labour market regulation – have the largest potential for labour-supply responses in reaction to negative shocks.

61. More generally, *ex ante* (*i.e.* before insurance payment), “less elastic” individuals will be more affected by macroeconomic shocks. Insurance mechanisms will induce more individuals to become “less elastic” *ex post*.

protected permanent contracts.⁶² Similarly, groups with high bargaining or “nuisance” power may escape bearing adequate amounts of certain risk (*e.g.* farmers, truckers, taxi drivers). Powerful groups may influence risk sharing both directly in the wake of shocks, and indirectly by shaping *ex ante* the design of institutions – such as labour, product and financial market regulations – that have a bearing on how the costs of macroeconomic shocks are spread across society.

62. It has also been argued that for certain shocks (*e.g.* inflation shocks) the middle class typically bears an overly large share of the burden, resulting from the poor being too poor to shoulder much of it, and the rich having specific possibilities to avoid it.

3. EVIDENCE ABOUT REDISTRIBUTIVE EFFECTS OF SELECTED MACROECONOMIC SHOCKS

36. An analysis of how institutional settings affect risk-sharing outcomes requires first some understanding of how macroeconomic shocks affect different population groups and how, in turn, institutions shape these outcomes. To guide policy considerations, this section therefore presents evidence first on the former and then on the latter issue. The analysis presented in this section considers shocks to exchange rates, commodity prices, inflation, interest rates, productivity, as well as financial crises and fiscal shocks.⁶³ Differential effects of these shocks are analysed across a number of household groups. The focus is on cross-country time-series empirical analysis spanning several decades wherever sufficient data are available. It should be noted that the analysis consciously focuses on what presumably is the main concern of policymakers, namely the short- and medium-term distributional impact of shocks (*i.e.* on effects up to five years after the shock).⁶⁴ In addition, the empirical work is complemented by DSGE model-based analysis, in particular for shocks or household groupings for which data are scarce. The economic literature on the distributional impact of macroeconomic shocks is surveyed in an annex, which also features further details on the empirical analysis.

3.1 Empirical analysis

37. Macroeconomic shocks can have distributional effects along a number of dimensions. The empirical analysis presented here focuses on population groups distinguished by income and wealth position,⁶⁵ educational attainment, sex, and age. In addition, the analysis examines the effects of selected shocks on net borrowers and net creditors, as well as on homeowners and tenants.⁶⁶ Finally, a distinction is made between households that draw significant amounts of income from capital (*i.e.* the top quartile of capital income earners) and remaining households.⁶⁷ Since income and wealth data are readily available only for some of these groups, new indicators have been compiled from the household survey data assembled in the Luxembourg Income Study (LIS). Given the focus of this paper on risk sharing, the analysis reports the *relative* impact of the shocks on the different groups rather than absolute effects.

63. Identifying macroeconomic shocks is inherently difficult. For some omitted but potentially interesting shocks, meaningful identification was impossible or the number of identified shocks would have been too low to allow for econometric analysis.

64. Consequently, for shocks where the distributional impact does not start to fade within five years, the analysis does not answer whether the distributional impact of the shock is permanent or not.

65. The choice of the different dimensions treated here was strongly constrained by the availability of data. Available information on income inequality includes the share of household income accruing to each quintile of the income distribution, Gini coefficients and relative poverty rates. See Table A1 in the annex for details on data sources.

66. While in principle the basic unit of analysis can be either the individual or the household, data on financial variables is generally more widely available at the household level, which is why most of the subsequent empirical work focuses on this level. For individual characteristics such as age and educational attainment, the characteristics of the household head – generally the person with the highest income within a household – have been chosen to represent the household.

67. In practice, some of these groups show a certain overlap.

3.1.1 Methodology

38. Identifying macroeconomic shocks is not a straightforward task. In most theoretical models, a shock is an entirely exogenous event affecting an economy. In the data, however, it is hard to infer the degree of exogeneity of observed events, and a systematic approach for identifying such exogenous shocks, such as *e.g.* by estimating series of VARs for multiple individual shocks and a large number of countries, is beyond the scope of this paper. Also beyond the scope of this paper would be to set up theoretical models for each of the dependent macroeconomic variables (*e.g.* income inequality, employment for different education groups, *etc.*). For this reason, shocks are first identified by comparing the size of yearly changes in the considered variable (*e.g.* commodity prices for commodity price shocks) to the overall sample variation across countries and time. A dummy variable is then constructed that takes value 1 when movements exceed a certain number of standard deviations, where different stringency criteria (*e.g.* 1.5, 2 or 2.5 standard deviations) are applied to check for the robustness of the empirical results.⁶⁸ Separate variables are created for positive and negative shocks to allow for asymmetric effects.⁶⁹ Shocks have been defined in this way for exchange rates, commodity prices, inflation, interest rates and the fiscal stance (see Box 6).⁷⁰ This procedure marks on average around 2% of the observations of the relevant macroeconomic variables as years of macroeconomic shocks, with a range between 1% and 6% depending on the type of shock and on the stringency criteria applied. The maximum coverage of the panel data used in the analysis includes 40 countries and approximately 50 years, although for a number of variables the effective size of the data set is smaller.

Box 6. Methodologies for constructing the different macroeconomic shocks

Shocks are by necessity stylised, and while great care has been applied to defining them in an intuitively reasonable and robust fashion, and in checking for sensitivity to alternative identification criteria, other sensible ways of constructing shocks always exist.

Exchange-rate shocks are identified based on changes in real effective exchange rates calculated by the OECD. These rates account for differences in price levels, and are constructed as weighted averages across trading partners and goods traded. Commodity price shocks are identified on the basis of movements in each country's commodity terms-of-trade, where different commodities are weighted by their relative importance for each country. The subsequent econometric analysis distinguishes between net commodity importers and net commodity exporters, because the economic mechanisms at play may in principle differ across these two groups of countries. Fiscal consolidation and expansion shocks are derived from changes in the residuals of a regression of structural fiscal balances on the output gap, so as to control for the possibility of remaining endogenous, business cycle-driven changes in structural fiscal positions.

Inflation and disinflation shocks are constructed from changes in consumer price inflation rates.¹ Interest-rate shocks are considered both with respect to short-term policy rates and long-term bond rates. For the identification of policy rate shocks, normal monetary policy reactions to cyclical or inflation developments are removed by using residuals obtained by estimating Taylor rules. While this remains an imperfect approach, it by and large ensures that

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68. This transformation into a binary variable also drastically reduces the potential econometric issues arising from the fact that some of the underlying macroeconomic variables are estimated, such as interest rates or fiscal balances.
69. The use of different stringency criteria and of separate variables for positive and negative shocks is also useful because standard deviations may be influenced by long-run trends in some of the underlying variables, which could make it more or less difficult for a movement in the variable to qualify as a shock based on a single criterion.
70. The impact of fiscal shocks on various groups (*e.g.* low- versus high-income households) can be expected to vary depending on the type of tax and spending items affected. Therefore, shocks to the fiscal stance may be qualitatively different from the other examined shocks insofar as they are not only shocks to the economy, but also potentially to different types of risk-sharing mechanisms themselves.

shocks are not picking up normal cyclically-driven policy reactions. As data on term spreads are not available for a sufficiently large part of the sample, long-term interest-rate shocks are based on changes in long-term nominal interest rates deflated by inflation expectations. For reasons of data availability, inflation expectations are proxied by CPI inflation over a 10-year rolling window (half forward, and half backward-looking). The resulting shocks are very similar to those obtained from the use of survey-based long-term inflation expectations where such data are available.

Finally, information on financial crises is taken from Reinhart and Rogoff (2009), who compile a database of banking crises across the world going back more than a century. They identify banking crises on the basis of either bank runs that lead to the closure, merging or takeover by the public sector of one or more financial institutions or – if there are no runs – the closure, merging or takeover of, or large-scale government assistance to, an important financial institution that marks the start of a string of similar outcomes for other financial institutions.

In principle, the method used to identify shocks implies a risk that some of them may in fact capture endogenous responses to other “genuine” shocks (e.g. the monetary policy shock variable might reflect some response to e.g. commodity price shocks). In practice, however, pair-wise correlations between different types of shocks are low.² Moreover, the standard deviation criterion used to identify the shocks makes their identification relatively robust to normal fluctuations in the underlying macroeconomic variables. Since only large changes are scored as one, it is highly likely that the events identified have a strong “genuine” shock component even when some of the changes in the macroeconomic variables considered are not fully exogenous.

1. In order to account for the trend decline in inflation over the sample period, the relevant standard deviation used here is an average of the standard deviation over the entire sample and a ten-year rolling window across the sample for any given year.
2. This holds both for simultaneous correlations and correlations including lags. The largest correlation observed is 0.15 between the dummy variables that capture shocks to short- and long-term interest rates, which comes as no surprise as shocks to short rates would be expected to some degree to be reflected in long rates. Similar but even lower correlations were also observed between financial crises and negative exchange-rate shocks, and between positive interest-rate and disinflation shocks.

39. In a second step, relying on the constructed macroeconomic shock variables, impulse responses to the shocks are estimated for the different groups mentioned above (see the annex for a detailed description of the analysed distributional variables). The links between the distributional variables and shocks are analysed in a relatively simple empirical framework suggested by Teulings and Zubanov (2009). This framework (see Box 7 for more details) is used to identify effects from shocks up to five years after their occurrence.

Box 7. The empirical framework for the income and employment analysis

The relationship between macroeconomic shocks and the income distribution and employment variables is analysed in a relatively simple dynamic regression framework. The empirical analysis aims to capture the effects of different shocks on changes in the distribution of household income across different groups, while avoiding the need to construct a fully-fledged structural model of the steady-state determinants of this distribution.¹ In a similar context, Cerra and Saxena (2009) apply an autoregressive estimation technique to analyse the effects of financial crises on GDP growth. Their approach avoids the need for a structural empirical model by using several lags of the dependent variable as explanatory variables and is able to derive how the dependent variable reacts to shocks over time. However, because the so-called impulse-response functions are calculated recursively in this approach, they have been criticised for being sensitive to small specification or estimation errors that always exist in practice. Teulings and Zubanov (2009) therefore suggest a related estimation technique in which the coefficients of the impulse response function are estimated directly for each time horizon, thus making the method more robust. This approach, which has also been applied in recent OECD work (Duval *et al.*, 2010), is followed in the present analysis. In order to obtain estimates for the effects of the different shocks and for how these shocks interact with different institutional settings, shocks and institutions are added into the regression framework as interaction terms. In particular, equations are estimated for each of the five years following the occurrence of a shock, where an example equation for the year after the shock ($t+1$) takes the form:

$$Y_{it+1} - Y_{it} = \alpha + \sum_{j=0}^3 \beta_j \Delta Y_{it-j} + \gamma_1 SHOCK_{it} + \delta_1 SHOCK_{it} * INST_{it} + \varepsilon_1 INST_{it} + \bar{\theta} \cdot \overline{COVAR}_{it} + \mu_t + \eta_{it}$$

In this set of equations, Y_{it} measures the distributional variable of interest. It is regressed on three years of lagged differences,² time fixed effects μ_t , and a set of covariates (covar) that control for possible cross-country differences including population, GDP per capita, the foreign asset position, a measure of geographical remoteness and the share of commodity exports in a country's total exports. Although country fixed effects are not explicitly present in this estimation

equation due to the lack of sufficient time variation in many of the analysed variables, the dependent variable is in differences across which removes the effect of all constant cross-country differences. The focus is on the coefficients γ and δ that measure the response of the distribution variable to the shock in interaction with different institutional settings, looking up to five years into the future from the year of occurrence of a macroeconomic shock. The parameter estimates for γ and δ are used to calculate marginal effects of the shock variable for a high level (66th percentile) and a low level (33rd percentile) of the institutional variable, for each of the five years.

A graphical example of the estimated marginal effects is depicted in the chart below, which shows the estimated increase in the poverty rate following fiscal consolidations under different levels of countries' transfers and benefit systems (as measured by general government transfers as a share of GDP). In this case, the lower bound of the arrows represents the effect of fiscal adjustments on poverty rates under generous transfer and benefit systems, while the upper bound represents the same effect when transfer and benefit systems are relatively less developed. The effect is statistically significant in the years 2-5 following the fiscal shock, as indicated by arrows, while it is not statistically significant for $t+1$, indicated by a light dotted floating column instead. Stars on the horizontal axis indicate the level of statistical significance, following conventional notation of 1,2,3 stars for statistical significance at the 10, 5, and 1% levels. The lesson to draw from these estimation results would be that fiscal consolidations increase poverty rates, and that these increases are lower under more generous transfer and benefit systems.

Increases in poverty are lower under more developed welfare systems following fiscal consolidation

Source: OECD calculations. ** and * represent statistical significance at the 5 and 10% level, respectively.

1. While the analysis accounts for changes in the relative situation of a given group, it abstracts from possible transitions of given individuals between groups.
2. Teulings and Zubanov use specifications with and without the lagged difference terms. These terms were kept in to control for a maximum of unobserved influences that are not related to macroeconomic shocks, although robustness checks indicate that the inclusion of these lagged differences does seem to not affect the results much.

40. In addition to the effects on income (and employment), the empirical work also aims to shed light on how household wealth is affected by macroeconomic shocks.⁷¹ However, data on the wealth holdings of households with different characteristics are considerably more limited than for income, implying that wealth analysis has to rely on simulations rather than on econometrics. In addition, the precision of the wealth analysis may be adversely affected by data limitations, as indirect asset holdings such as wealth held in pension plans or arising from pension claims are not included. For this paper, indicators on wealth holdings are constructed using the Luxembourg Wealth Study (LWS). Sufficiently detailed information is available for a cross-section of four countries in the early 2000s (Canada, Italy, Sweden and the United States), which form the basis for the wealth analysis in this paper. These data provide information on how

71. For some shocks (e.g. on interest rates), where income and wealth effects may have opposite signs, it is hard to establish a general welfare analysis, given the incompleteness of available data.

the wealth of different households is distributed across asset classes which, combined with information on how different asset prices are typically affected by various shocks, allows an approximation of the first-round effects of these shocks on wealth. Results from the wealth analysis are discussed in Box 8 below.

3.1.2 Empirical results by groups

41. This section first briefly examines how shocks affect domestic versus foreign residents, before turning to the question of how shocks have affected the wealth and income distribution within countries.

3.1.2.1 Impact of shocks on domestic versus foreign residents

42. The empirical framework used in this paper can be used to explore the distributional effects of shocks not only across residents of a country, as is done below, but also between different countries at the aggregate level. A macro-data based analysis of the extent to which shocks affect a country's current account balance suggests that a number of the shocks analysed above are indeed partly exported to trading partners.⁷² In addition to the expected reaction of current account balances to exchange-rate and commodity price shocks, fiscal consolidation shocks are found to have quite sizeable effects, most likely through reduced demand for imported goods. Five-year episodes of fiscal consolidation, corresponding to an average improvement in the cyclically-adjusted fiscal balance of slightly over 7 percentage points, have on average triggered overall improvements in the current account of almost 3 percentage points.⁷³ These effects are broadly in line with recent IMF and OECD estimates by Abbas *et al.* (2010) and Kerdrain *et al.* (2010), respectively. Financial crisis is another type of shock that has been found to improve the current account balance, again probably *via* reduced import demand. Similarly, disinflation shocks have also improved current accounts, likely reflecting slow and/or incomplete nominal exchange-rate adjustment- as is likely under fixed exchange-rate regimes.

3.1.2.2 Income distribution analysis of shocks

43. Based on the empirical framework described above, the following presents selected income effects of past macroeconomic shocks, with the full set of results summed up in Table 1. Supplementary analysis on wealth distribution is provided in Box 8. A general finding from the income distribution analysis is that negative macroeconomic shocks are far more likely to affect the relative position of different groups than positive macroeconomic shocks, for which – with the notable exception of fiscal expansions – few or no distributional effects were found. A finding that arises for almost any negative macroeconomic shock is a particularly negative effect on unemployment and employment of youths, with the latter possibly to some degree reflecting youths finding it more advantageous to continue education rather than join the labour force in difficult times. For some shocks, a similar negative labour market effect is also found for older workers. In what follows, the remaining results are discussed for each shock. For shocks not reported in the table, no significant distributional effects were found.

72. For an examination of the link between changes in the current account and capital mobility see for example Pelgrin and Schich (2008).

73. However, it should be noted that these effects are estimated all else equal, so that history provides little guidance as to the effects of fiscal consolidation in a situation where a large number of countries would consolidate simultaneously.

Box 8. The effects of macroeconomic shocks on wealth distribution: results from wealth data analysis

The available micro data on wealth distribution show that households that receive large amounts of capital income differ substantially from others both in the size and structure of their asset holdings.¹ The portfolios of the top receivers of capital income include a majority of business assets and stocks, while the largest item in the asset portfolios of all other households tends to be real estate (see Figure A). Reflecting these marked portfolio differences, the wealth effects of macroeconomic shocks are largely determined by their effects on different asset prices. Analysis of how different shocks affect asset prices finds that financial crisis and currency depreciation shocks come with significant and protracted declines in housing prices. This is in line with the findings of other studies, such as Reinhart and Rogoff (2008) who document prolonged declines in housing prices averaging around 38% for 13 financial crises over the last 30 years, including both developed and emerging markets. In contrast, equity price declines have been substantially more modest and short-lived, with a complete recovery generally reached after three years. Consequently, financial shocks should in general have a less negative effect on the wealth of households with large shares of capital income than on others. Given that these households tend to be among the highest earners of total income, the finding that their *wealth* holdings are less affected than those of other households contrasts with the earlier result that their *incomes* take a relatively stronger hit in the wake of financial crises. This could e.g. be related to the fact that for wealthier agents capital income (as compared to labour income) represents a bigger share of their income, implying that even a smaller impact on their wealth may have a larger impact on their income.

A. Wealth portfolio differences between households with high versus low capital income

Source: OECD calculations based on Luxembourg Wealth Study. Based on gross wealth data for the United States, Canada, Sweden and Italy, averaged across these four countries.

Comparing wealth across different levels of age and education, the most salient differences are with respect to the level of leverage of households (see Figure B). The leverage factor, calculated as the ratio of gross assets to net wealth, peaks at the age of 26-35 at a level of around 2.5, while steadily declining thereafter. This may reflect that many households take up debt to buy real estate between the mid-20s and mid-30s and repay it gradually thereafter.

Less pronounced but nonetheless visible differences in leverage can also be observed across different levels of education, with leverage rising in the level of education of the household head. One possible explanation may be that more educated households expect higher future income streams relative to their net wealth and also face lower credit constraints, thereby enabling them to take out more debt.

Box 8. The effects of macroeconomic shocks on wealth distribution: results from wealth data analysis (cont.)**B. Household leverage factors by age and education groups**

Source: OECD calculations based on Luxembourg Wealth Study. Based on gross and net wealth data for USA, CAN, ITA, SWE. Leverage factor defined as gross assets divided by net wealth.

Different levels of leverage have a direct bearing on the vulnerability of households to macroeconomic shocks, because any effect on gross wealth from changes in asset prices will – all else equal – translate into a stronger effect on net wealth for more leveraged households. For example, the large house price declines associated with past financial crises and currency depreciations would imply lower declines in the net wealth of older and less educated households, due to their lower leverage (abstracting from the youngest age group whose wealth levels are low). This holds insofar as leverage is the dominant influence and there are no large systematic differences with respect to portfolio composition across age and education groups, and indeed only minor differences are observed in the data. In particular, real estate assets are by far the largest component of household wealth for all age and education groups.

Besides income, age and education, a further distinction is made in the empirical analysis between households that are net borrowers and those that are net lenders,² and another – somewhat related – between those that own a dwelling and those that do not. For these two dichotomies, the empirical evidence suggests that positive shocks to interest rates (both policy and long rates) have had a negative effect on the relative income of homeowners *vis-à-vis* tenants. One simple explanation for this effect may be that tenants tend to hold a large share of their wealth in deposits whereas housing assets account for the bulk of homeowners' wealth holdings (Figure C, right panel). Tenants may therefore benefit directly from increasing interest rates, while the income of homeowners may be linked less strongly to interest rate hikes.

With regard to wealth, two differences stand out when comparing borrower and creditor households. First, by definition, households that are net borrowers are more leveraged – almost three times more – than net creditor households. Second, borrowers' wealth portfolios consist overwhelmingly of real estate, while creditor households have more balanced portfolios across different asset categories (Figure C, left panel). Both features together imply that debtor households are significantly more vulnerable to financial crises and the associated house price declines.

Comparing homeowners' with tenants' wealth, a similar picture emerges. Like net borrowers, with whom they in fact overlap, homeowners are more leveraged – almost twice as much – than tenants. As mentioned earlier, they hold most of their wealth in the form of housing assets, while tenants hold a very large part in deposits, followed by mutual funds (see Figure 4, right panel). Both observations together imply that the wealth of households that own a dwelling is substantially more sensitive to shocks associated with large declines in house prices, such as financial crises, than that of tenants.

Box 8. The effects of macroeconomic shocks on wealth distribution: results from wealth data analysis (cont.)**C. Wealth portfolio differences for borrowers versus creditors and owners versus tenants**

Source: OECD calculations based on Luxembourg Wealth Study. Based on gross wealth data for the United States, Canada, Sweden and Italy, averaged across these four countries.

1. This group of households is defined as the top 33% earners of capital income in a given country before the shock.
2. Net borrower households are defined as households whose total debt exceeds their bond and deposit account assets, while the remaining households are labelled net lenders.

Financial crises

44. Financial crises seem to reduce the income share of the highest income quintile⁷⁴ to the relative benefit of the upper middle classes,⁷⁵ although the latter do not gain in absolute terms. One possible explanation for the over-proportional effect on top incomes may be that sectors with high labour incomes (e.g. banking) may be particularly hard hit by financial crises. Another factor is that capital income – which is concentrated in the higher income strata – may be particularly vulnerable to financial crises as suggested also by the DSGE analysis presented in Section 3.2. At the other end of the income scale, poverty rates have tended to rise in the aftermath of financial crises. The analytical results are basically in line with the literature surveyed in the annex.

Fiscal shocks

45. Strong fiscal consolidations are, over the sample, found to have reduced the income share of the two lowest quintiles of the income distribution, increasing income inequality and poverty, with opposite effects obtained for fiscal expansions. Insofar as social transfers were cut during past fiscal consolidations, low-income households may have been particularly affected. Similarly, public programmes aimed at helping the poor may be better funded during times of fiscal expansions. While the aforementioned

74. The negative effect on high income earners is restricted to countries with sufficiently developed financial markets (see below).

75. Upper middle classes are defined as the 4th highest quintile of the income distribution.

empirical findings are roughly in line with the scarce literature on the subject,⁷⁶ it should be kept in mind that fiscal packages can in principle be designed in many different ways, and fiscal consolidations or expansions do not *a priori* imply a particular distributional impact.

Interest-rate shocks⁷⁷

46. In contrast, interest-rate shocks (defined as policy rate increases well above what a simple monetary policy rule requires, *i.e.* far beyond what short-term cyclical and inflation developments would imply) appear to have decreased inequality by raising the income share of the three bottom quintiles to the detriment of the highest quintile. Similarly, interest-rate shocks have decreased the income share of households with high capital income. This likely arises as wealth holdings of those with high capital income contain larger shares of assets (such as stocks) whose returns usually suffer from higher interest rates, whereas other households hold larger shares of assets (deposits) whose returns may increase with interest rates. This is also in line with the DSGE analysis presented in Section 3.2 below that shows upward interest-rate shocks to redistribute income from shareholders to bondholders.

Inflation shocks

47. No robust results for income or employment were obtained for inflation shocks, possibly due to the fact that inflation shocks can have different origins (*e.g.* being driven by supply or demand-side factors) that would be expected to have dissimilar distributional implications. While the literature provides some empirical evidence that very high inflation has been detrimental to poorer segments of society,⁷⁸ more recent panel analysis has failed to find such a systematic distributional effect.⁷⁹ All in all, while the experience of some countries points to large redistributive effects from some inflationary episodes,⁸⁰ such effects could arise through shifts in wealth rather than in income. Particularly income effects may also vary strongly with the source and magnitude of the shock and may therefore not be detectible with the systematic approach taken here. Even in the absence of income effects, changes in relative prices that may especially arise in the wake of inflation, exchange-rate or commodity price shocks can still affect the relative well-being of different social groups, reflecting differences in their consumption patterns.

Commodity price shocks

48. Analysis based on the sample of net commodity importers⁸¹ points to significant effects of upward commodity-price shocks on poorer parts of society, through both a decline in the share of income accruing to the two bottom income quintiles, and an increase in poverty.⁸² These findings may reflect the

76. See for example Roine *et al.* (2009), Cardoso (1992), Morley (1995), Lopez (2003), or Jensen and Rutherford (2002).

77. This section only deals with shocks to short-term interest rates. No robust analytical results were obtained for the variable intended to proxy for shocks to long-term interest rates, probably reflecting the severe data limitations and ensuing low accuracy of the variable intended to measure these shocks.

78. See Easterly and Fischer (2001).

79. See Agenor (2004).

80. See *e.g.* Ferreira and Litchfield (1999), Datt and Ravallion (1998), or the literature on the inflation during Germany's Weimar Republic for historic examples.

81. The few countries that are net commodity exporters were excluded from the commodity price shock analysis to facilitate the interpretation of results.

82. This is consistent with Agenor (2004) who finds that terms-of-trade improvements significantly lower poverty.

general tendency for poor households – which typically have a below-average level of education – to be the first to suffer job losses as activity declines. The income losses experienced by low-income households in the face of commodity price hikes may be a particular concern because they come on top of a reduction in their relative purchasing power as commodity products (*e.g.* gasoline or energy) typically account for a larger share of their expenditures. Upward commodity price shocks also reduce the income share of those with high capital income, possibly reflecting shrinking profits as firms face rising costs for commodity-related inputs.

Exchange-rate shocks

49. While devaluation shocks are found to increase income inequality,⁸³ sharp currency appreciations reduce it by increasing the income share of the two bottom quintiles, and reducing the share of the highest quintile. Since currency appreciations are likely to reduce profits in tradable sectors, it is conceivable that the resulting reductions in capital income from these sectors would result in larger adverse income effects in the top income ranges. The findings that appreciations mainly profit poorer households is in line with other studies highlighting the political popularity of exchange-rate appreciations in Latin America.⁸⁴

Table 1. Synthesis of empirical findings on the distributional impact of macroeconomic shocks

Financial crises	<ul style="list-style-type: none"> • increase income share of third and fourth quintile (Q3, Q4) • reduce income share of Q5 • increase poverty • worsen relative labour market outcomes for youths (unemployment , employment), seniors (unemployment) and women (employment) • improve relative employment performance of those with tertiary education
Fiscal consolidations	<ul style="list-style-type: none"> • reduce income share of Q1, Q2 • increase inequality (GINI coefficient) • increase poverty • worsen relative labour market outcomes for youths (unemployment, employment) and seniors (employment)
Fiscal expansions	<ul style="list-style-type: none"> • increase income share of Q1, Q2 • reduce income share of Q5 • reduce inequality • reduce poverty • increase income share of youth • increase income share of pensioners • enhance relative labour market performance of youths (unemployment) and seniors (unemployment, employment)

83. For similar results see Baldacci *et al.* (2002).

84. See *e.g.* Bahmani-Oskooee (1997) or Carvalho Filho and Chamon (2008).

Table 1. Synthesis of empirical findings on the distributional impact of macroeconomic shocks (*cont.*)

Exchange-rate devaluations	<ul style="list-style-type: none"> • reduce income share of Q1, Q2, Q3 • increase income share of Q5 • increase inequality • worsen relative labour market outcomes for youths (unemployment, employment) and seniors (unemployment)
Exchange-rate appreciations	<ul style="list-style-type: none"> • increase income share of Q1, Q2 • reduce income share of Q5
Interest-rate shocks (policy rate increases)	<ul style="list-style-type: none"> • increase income share of Q1, Q2, Q3 • decrease income share of Q5 • decrease income share of households with high capital income • decrease inequality • worsen relative unemployment and employment outcomes for youths • reduce income share of home owners
Negative commodity-terms-of-trade shocks (commodity price increases)	<ul style="list-style-type: none"> • decrease income share of Q1, Q2 • decrease income share of households with high capital income • increase poverty • worsen relative unemployment and employment outcomes for youths
Positive commodity-terms-of-trade shocks (commodity price decreases)	<ul style="list-style-type: none"> • increase income share of Q1 • reduce inequality

3.1.3 The role of institutions

50. This section examines how institutions shape the distributional effects of macroeconomic shocks discussed above. A wide range of institutional variables are considered covering the size of government revenue, the generosity of welfare spending, the structure of the tax system, labour market institutions, financial development, the exchange-rate regime, the quality of legal framework conditions, product market regulation, international openness, and the human capital of the labour force (for a full list of examined institutions, see Table A1 in the Annex).

3.1.3.1 Government size, welfare system and tax structure

Size of government, generosity of welfare system, and unemployment benefits

51. A more developed welfare system, and especially more generous unemployment benefits, have strongly dampened negative effects of certain shocks on more vulnerable groups (see Table 2). For example, in the aftermath of both financial crises and fiscal adjustments, larger social transfers or higher replacement rates (especially in the first year) appear to have limited increases in poverty (Figure 1, Panel A). In the wake of financial crises, more generous unemployment benefits have also dampened an otherwise particularly negative income effect for seniors (55-65), as shown in Panel B of Figure 1, and reinforced the relative income loss of high-income individuals (fifth quintile, Q5).

Figure 1. Distributional impact of unemployment benefits in the wake of financial crises

52. While unemployment benefits unsurprisingly appear to provide insurance against aggregate income losses for weaker groups, they also seem to have adversely affected the job prospects of certain groups in the wake of shocks, possibly via their effect on search incentives or the wage-bargaining process. For example, higher replacement rates – especially for the first year – have led to particularly adverse employment outcomes for youths in the wake of financial crises (Figure 2, Panel A), devaluation and upward interest-rate shocks.⁸⁵ Longer benefit duration has also weakened the relative employment performance of those without tertiary education after financial crises. Similarly, relative unemployment increases for older workers have been more pronounced where unemployment benefits were long-lasting (Figure 2, Panel B), indicating that some of the elderly that became unemployed during fiscal consolidations *de facto* pre-retired.⁸⁶

85. This might reflect smaller downward real wage flexibility that may be especially detrimental to labour market outsiders such as youths. Alternatively, this could point to a marked incentive effect that lowers the intensity of their job search, although such an effect would *a priori* be expected to be stronger for groups with longer work histories and therefore higher benefit levels and/or durations.

86. Indeed unemployment benefit schemes have been used as *de facto* early retirement schemes in a number of (mostly continental European) OECD countries (Duval, 2003).

Figure 2. Labour market impact of unemployment benefits

Structure of tax system

53. A higher labour tax wedge is found to have worsened relative employment and unemployment outcomes for groups with a lower attachment to the labour market. For example, a higher tax wedge has worsened the relative labour market performance of young and older workers following devaluation shocks (Figure 3, Panel A), as well as of youths in the aftermaths of financial crises and upward interest-rate shocks. This would be consistent with marginal labour market groups being particularly affected under high tax wedges in the wake of shocks. High tax wedges have also hampered reductions in income inequality in the wake of upward interest-rate shocks. Finally, with more progressive tax systems, fiscal expansions have typically led to larger reductions in poverty (Figure 3, Panel B).

Figure 3. Distributional impact of tax system

3.1.3.2 Labour market institutions

Employment protection legislation (EPL)

54. Stricter EPL is found to provide some social protection for either the less well-off or the middle classes in the wake of negative shocks and has also improved the employment performance of older workers while weakening that of younger workers. More precisely, stricter EPL is estimated to have increased the income share of individuals that do not have high capital income in the wake of upward interest-rate shocks, and dampened increases in poverty following fiscal adjustments (Figure 4, Panel A). In the wake of financial crises, stricter EPL has also increased the redistribution of income away from the poor and the rich towards the middle classes (Q3,Q4). Following a number of negative shocks (including financial crises or devaluations), stricter EPL has mitigated the deterioration in labour market outcomes for those above 50, while amplifying it for those in their twenties (Figure 4, Panel B).

Figure 4. Impact of EPL on poverty and youths' labour market performance

Minimum wages

55. Minimum wages are in some instances found to have had beneficial income effects for less well-off (see Table 2), but at the price of increased youth unemployment (Figure 5). Both the level and – especially – the reach of statutory minimum wages play a role for labour market performance of youths, consistent with the view that minimum wages reduce the flexibility of low-skilled wages in the event of shocks, with adverse effects on their ability to retain their jobs or find new ones. More specifically, both relative employment and unemployment of individuals in their twenties have been adversely affected by more stringent minimum wage settings in the wake of financial crises, fiscal consolidations, as well as upward commodity price, upward interest rate, and devaluation shocks.

56. Upward commodity price shocks also reduce the income share of individuals with relatively high capital income, and this effect increases with a wider reach of the statutory minimum wage. This empirical finding could reflect a squeeze in profits and is broadly consistent with the theoretical findings of the DSGE analysis presented in Section 3.2. Upward commodity price shocks in a commodity-importing country can be seen as qualitatively similar to negative productivity shocks insofar as both increase production costs, and in the DSGE model-based analysis negative productivity shocks are especially bad for capital holders if wages are rigid downwards.

Figure 5. Impact of reach of statutory minimum wage on youths' labour market performance

Strength of labour unions and collective bargaining mechanisms

57. Stronger labour unions have played an important insurance function for weaker groups in the aftermath of certain shocks. For example, stronger unions have lessened negative effects from devaluation shocks on the income share of poorer workers (Q2), while limiting relative income gains for the rich (Q5). This may reflect the ability of unions to achieve some compensation for depreciation-driven real income loss for those with low individual bargaining power. Under upward commodity price shocks, broader coverage of collective bargaining appears to have magnified the income loss of high capital income earners (Figure 6, Panel A), possibly reflecting that firms incur a larger reduction in profits when they are less able to pass the burden on to wages. After exchange-rate appreciations, broader coverage of collective bargaining mechanisms has also increased the income share of the poor (Figure 6, Panel B), possibly reflecting greater resistance to nominal adjustment in the wake of appreciation-driven real wage increases for low-wage earners. However, stronger union coverage is typically found to improve the labour market performance of prime-age groups to the detriment of youths in the aftermath of shocks (financial crises, fiscal consolidations, as well as devaluation, upward commodity price and interest-rate shocks), consistent with stronger insider-outsider effects.

Figure 6. Distributional impact of wage-bargaining arrangements

Degree of centralisation of wage bargaining

58. During fiscal expansions more centralised wage-bargaining mechanisms have dampened increases in the income share of the poor (Q1, Q2), while similarly dampening losses for the income share of high income earners (Q5), as shown in Figure 7. This could reflect unions better factoring macroeconomic developments into their claims under more centralised collective wage-setting mechanisms, *e.g.* moderating wage demands to achieve greater employment impact of stimulus.⁸⁷

Other labour market institutions

59. A higher effective retirement age has dampened the increase in the income share of seniors (55-65) during fiscal expansions. This possibly reflects that pension increases – which have been part of a number of past fiscal expansion packages – only benefit those who are already retired.

Figure 7. Distributional impact of more centralised bargaining following fiscal expansions

3.1.3.3 Product market regulation (PMR)

60. Stricter product market regulation is found to amplify the negative effects of certain shocks for youths and the poorer segments of society (see Figure 8 and Table 2). For example, stricter PMR has worsened unemployment and employment performance of youths after financial crises and devaluation shocks, and has had adverse income and unemployment effects for this age group during upward interest-rate shocks. These findings could result from less restrictive PMR allowing for quicker reallocation of resources across sectors and firms in the wake of adverse macroeconomic shocks (Arnold *et al.*, 2008), with greater turnover in labour markets improving the relative situation of youths. More rigid PMR has also had negative income effects on the poor following devaluations and commodity price decreases, and adversely affected poverty in the aftermath of financial crises and fiscal expansion shocks.

87. Note that fiscal expansions are defined as expansions beyond normal countercyclical policy.

Figure 8. Distributional impact of stricter product market regulation

3.1.3.4 Openness

61. Several dimensions of economic openness appear to soften the distributional effects of domestic shocks, particularly to the benefit of youths and the poor. For example, financial crises, fiscal consolidations or upward interest-rate shocks have had smaller adverse effects on youth labour market performance in more open economies, as measured by trade openness ratios or lower FDI restrictions (Figure 9, Panel A). Trade openness is also found to amplify the relative income gains of the lower classes (Figure 9, Panel B),⁸⁸ while capital account openness may amplify regressive distributional effects in certain instances (see Table 2). Overall, these results may reflect the dampening effect of FDI and trade openness in the event of domestic shocks, which may primarily benefit those with the highest probability of otherwise being laid off such as youths and workers with low productivity. Openness, however, would at the same time be expected to strengthen the transmission of international shocks to the domestic economy.

Figure 9. Distributional impact of a more open economy

88. These results are consistent with findings in the literature that show long-term benefits for the poor from economic openness. For a literature survey see Winters *et al.* (2004).

3.1.3.5 Financial development

62. In financial crises, a more developed financial sector is estimated to have worsened the labour market performance of youths and women. This may reflect that larger financial sectors make such crises more acute, with particularly large effects on groups with weaker attachment to the labour market. A larger financial sector also appears to increase the negative impact of both financial crises and upward interest-rate shocks on the income share of high incomes (Figure 10). This may be connected with a larger collateral effect under higher financial development. The DSGE analysis presented in Section 3.2 shows that more sophisticated financial markets magnify the negative impact of financial crises (or interest rate increases) on capital holders, in essence because of higher leveraging of capital holders requiring more painful deleveraging during financial turmoil.

Figure 10. Distributional impact of higher financial development

63. Finally, devaluation shocks are found to increase inequality, and to have a larger negative impact on the income share of the poor (Q1,Q2) when the financial sector (and specifically credit) is more developed. One potential explanation could be that financial development may facilitate credit and overinvestment in non-tradables such as housing during periods of exchange-rate overvaluation, with the required larger economic adjustment in the wake of the devaluation resulting in larger negative effects on the poor.⁸⁹

89. Some other institutions are also found to alter the distributional effects of certain shocks. Lower levels of corruption are found to dampen adverse effects on poverty and the income share of the poor (Q1) from fiscal consolidations. This could be an expression of weaker individuals being taken better into account by fiscal authorities in a less corrupt surrounding. Higher human capital appears to dampen the negative income effect on those with high capital income in the wake of commodity price increases. A possible explanation may be that higher human capital coincides with production being more oriented towards technologically advanced goods and services which necessitate a lower input share of commodities. This in turn would soften the impact on profits of upward commodity price shocks.

Table 2. Summary table for results of institutional analysis

	Financial crises	Fiscal consolidations	Fiscal expansions	Exchange-rate devaluations	Exchange-rate appreciations	Interest-rate shocks (policy rate increases)	Negative commodity ToT shocks (commodity price increases)
More developed welfare system		-dampens increase in poverty -limits decrease in youths' income share	-enhances increase in youths' income share				
Higher unemployment benefits	-limit increases in poverty -dampen negative income effect for seniors -decrease income share of Q5 -deteriorate Imp of youths	-limit increases in poverty	-improve Imp of youths	-deteriorate Imp of youths & seniors		-positive income effect Q1 -deteriorate Imp of youths	
Longer duration of unemployment benefits	-deteriorates Imp of those without tertiary education	-deteriorates Imp of seniors					
Progressive system			-reduces poverty				
Higher tax wedge	-deteriorates Imp of youths			-deteriorates Imp of youths and older workers		-deteriorates youth Imp -adverse income effect for youths -dampens decreases in inequality	
More stringent EPL	-increases income share of Q3,Q4 -improves Imp of older workers -deteriorates Imp of youths	-dampens increases in poverty	-improves Imp of older workers	-improves Imp of older workers -deteriorates Imp of youths		-decreases income share of high capital income hh -negative income effect for youths	
Higher minimum wage							-deteriorates Imp of youths
Broader reach of statutory minimum wage	-deteriorates Imp of youths	-positive income effect Q2 -deteriorates Imp of youths		-deteriorates Imp of youths & seniors		-deteriorates Imp of youths	-deteriorates Imp of youths -reduces income share of high capital income hh
Stronger unions	-improve Imp of prime-age workers -deteriorate Imp of youths	-improve Imp of prime-age workers -deteriorate Imp of youths		-limits income losses for Q2 and gains for Q5 -deteriorate Imp of youths & seniors	-increase income share of Q1	-deteriorate Imp of youths -negative income effect for youths	-reduce income share of high capital income hh -deteriorate Imp of youths & seniors

Table 2. Summary table for results of institutional analysis (cont.)

More centralised wage bargaining	-improve Imp of prime-age workers -deteriorate Imp of youths		-dampens increase in income share of Q1,Q2 and decrease for Q5	-deteriorate Imp of youths			
Higher effective retirement age			-dampens increase in income share of seniors				
Higher PMR	-deteriorate Imp of youths -increases poverty		-adverse effect on poverty	-deteriorate youth Imp -reduces income share of Q1, Q2		-deteriorate Imp and income share of youths	
Greater openness to trade		-improves Imp of youths				- decreases inequality -improves Imp of youths -increases income share Q1, Q2, reduces it for Q5	
Greater openness to FDI	-improves Imp of youths						
Greater openness to capital flows				-increases inequality		-decreases income share of Q1-Q3, opposite for Q5	
Financial developm.: - importance of banking sector	-worsens Imp of youths and women -reduces income share of Q5			-increases inequality		-reduces income share of high capital income hh	
- importance of credit				-decreases income share of Q1,Q2			
- import. of stock market				-increases inequality			
Lower level of corruption		-dampens negative effect on poverty and income share of Q1					
Larger human capital							-dampens income share reduction of high cap incomes -increases poverty

Note: Imp – labour market performance, referring alternatively to unemployment, employment or both; hh – households.

3.2 DSGE model-based analysis

64. As a complement to the empirical analysis, the impact of selected shocks is investigated taking a model-based DSGE (dynamic stochastic general equilibrium) approach. Using a modelling framework allows to focus on shocks that are hard to measure in reality (like risk aversion shocks in financial markets), or to look at groupings (*e.g.* bond holders versus equity holders) for which data are inexistent or extremely limited. DSGE analysis also has the advantage of being able to generate general equilibrium results, and can help towards a better understanding of the transmission mechanisms of shocks.

3.2.1 Short description of the models

65. The analysis of distributional consequences of macroeconomic shocks in a DSGE framework requires models with heterogeneous agents. As traditional DSGE models generally use single representative agents, they cannot be used to study the distributional consequences of shocks, implying that models must be tailored to the specific needs of this paper. Specifically, the models used in this paper assume that forward-looking agents differ in various aspects such as preferences for asset holdings (*e.g.* nominal or real assets), or the existence of credit constraints (see also Monacelli, 2009). Modelling features are discussed in more detail in Box 9.

Box 9. DSGE models with heterogeneous agents

The *short-term* impact of macroeconomic shocks on different groups of agents is examined in the framework of several DSGE models. The constructed models build on the “credit view” of business cycles as formalised by Bernanke and Gertler (1989), incorporating borrowing constraints and collateral requirements as central features. In such a setting, shocks affect the real economy to a considerable degree via their impact on the borrowing capacity of economic agents. For example, a shock-driven increase in the net worth of borrowers increases their collateral, thereby relaxing their (in equilibrium binding) borrowing constraint. The resulting increase in borrowing boosts investment and economic activity. Correspondingly, drops in asset prices and the implied fall in the value of collateral result in decreases in credit contraction which reduces economic activity. In this set-up, lower credit and falling asset prices are not just reflections of a recession, but also a major factor depressing economic activity.

Model 1: Nominal bond holders versus real equity holders

The baseline model consists of two types of agents with heterogeneous preferences. One type of agent is assumed to invest in more risky equity, the other to save *via* bond holdings. Equity investors borrow money by issuing bonds. These bonds are bought by the other group of agents, who thus become holders of nominal assets. The bond issuers use levied funds principally to invest in firms, and consequently hold real assets, *i.e.* shares of the capital stock of firms. These bond issuers/equity holders are credit-constrained, with their borrowing capacity being limited by the value of their collateral, *i.e.* their equity. Bond holders and equity holders obtain income from interest payments and dividends, respectively. As a result of the borrowing constraint, in equilibrium the marginal return on capital (*i.e.* dividends) exceeds the bond rates.

While in practice owners of small enterprises frequently borrow money to purchase real assets, investors in larger enterprises often do not borrow to finance their investment. However, large enterprises usually finance themselves to a large degree *via* borrowing, implying that their share holders are, *de facto*, leveraged as a large part of the enterprises’ capital stock is financed by borrowing. Assuming that equity holders borrow to finance part of their assets is a simple stylised way to capture these features.

Model 2: Capital owners versus workers

The second model considers capital owners and workers. Most features are the same as in Model 1: a first group of agents holds shares of the capital stock of firms, receiving dividends as the main source of income. These agents are credit-constrained and have to provide collateral (capital) to borrow. The second group of agents (workers) holds nominal assets and – this being the main difference from Model 1 – also supplies labour to firms. Consequently, workers obtain labour income and interest payments. Both types of agents consume output produced by firms using capital and labour as inputs into production.

Models 1 and 2 are closed-economy models. They both allow for disturbances in financial intermediation

that increase equilibrium interest rate spreads and thereby lead to a contraction in credit. This departure from standard macroeconomic models, in which agents directly borrow and invest without financial frictions, is motivated by the experience of the recent financial crisis where many credit markets ceased to work properly as credit spreads sky-rocketed. Default, on the other hand, cannot be easily modeled and is therefore ignored here.

Macroeconomic shocks and institutions considered in the model simulations

Three shocks are simulated using these models: *i)* a productivity shock that makes production more efficient; *ii)* an inflation shock, *i.e.* an unexpected increase in the price level; *iii)* an increase in financial market risk aversion reflected in increasing credit spreads, referred to here as a financial crisis shock.

The redistributive impact of these shocks is analysed under different explicit or implicit institutional settings:

- Degree of financial market sophistication: More developed and sophisticated financial markets should relax borrowing constraints, for example through better possibilities for lenders to assess and share risk or through improved legal security of their claims. Higher borrowing constraints are hence interpreted as reflecting a lower degree of financial market sophistication.¹
- Central bank reaction function: Two scenarios are considered which differ in the strength of the central bank response to deviations from its inflation target (as reflected in the corresponding Taylor rule coefficient).
- Alternative scenarios are considered that differ in terms of the labour-supply elasticity, which in turn may partly reflect underlying institutions. For example, means-tested benefits may lower labour-supply elasticities.
- Degree of product market regulation (PMR), as reflected in the power of firms to determine the price of their products. Stricter product market regulation increases the monopolistic power of firms, which in turn allows them to charge higher mark-up on prices. In the first scenario, firms are assumed to set a high mark-up over the competitive price level, reflecting relatively strict product market regulation. In the second scenario a low mark-up is considered, corresponding to relatively low levels of product market regulation.
- Degree of wage flexibility. Two scenarios are evaluated, reflecting high and low degrees of real wage rigidity. Low wage flexibility may reflect frictions arising through preferences, labour market institutions, or the tax and benefit system. Possible examples are wage loss aversion, fairness considerations, union power, collective wage bargaining, minimum wages, unemployment benefits, or tax wedges.

1. Alternatively, tighter borrowing constraints could also be interpreted as resulting from lower competition, or more stringent financial market regulation.

2. The idea goes back to Fisher's (1933) debt-deflation explanation of the Great Depression.

3.2.2 The impact of institutions

66. Dynamic simulations of the two models are undertaken for three types of shocks (productivity, inflation, and financial crisis shocks), examining the impact of different institutions on distributional outcomes (see Box 9 for details, and Ahrend *et al.*, 2011, for a full description of the model and the simulations). The shocks themselves have the following distributional features in the two models, for reasons that are explained below: a financial crisis shock leads to redistribution from equity to bond holders, as well as from capital to labour. In contrast, both an upward inflation and positive productivity shocks redistribute (in relative terms) from bond to equity holders, as well as from labour to capital.

3.2.2.1 Financial market sophistication

67. Simulations show that in both models more sophisticated financial markets amplify the redistributive impact of the three shocks under consideration.

68. A *financial crisis shock*, defined as an increase in credit spreads, results in higher borrowing costs (Figure 11). Bond holders, whose income is derived primarily from interest payments, benefit from

the higher interest rates and a positive wealth effect from the disinflation brought about by the crisis. Higher borrowing costs, however, affect equity holders negatively, and imply a reduction in overall borrowing and therefore in investment and economic activity.⁹⁰ In turn, the connected drop in dividends and asset prices lowers the value of collateral, and the associated tightening of borrowing constraints reinforces the fall in investment and economic activity. Equity holders are also hit by a negative wealth effect from disinflation as nominal debt is unchanged. These effects increase with financial market sophistication, as the fall in the price of collateral results in larger decreases in borrowing possibilities when agents are initially more leveraged. This implies that financial crises have a bigger negative impact on the relative position of real asset holders (compared to nominal asset holders) when financial sophistication is greater. With respect to the capital/labour distinction, both labour and capital income decreases in the wake of a financial crisis shock with slowing economic activity. However, capital owners are also hit by a negative wealth effect from declining asset prices, resulting in a larger fall in their consumption. This redistribution from capital to labour is larger when financial markets are more sophisticated, as in this case financial crises have stronger negative effects on asset prices.

69. An upward *inflation shock*, defined as an unexpected increase in the price level, boosts economic activity as it relaxes the borrowing constraint reflecting the increased nominal value of collateral and an unchanged nominal debt. Financial market sophistication increases the sensitivity of borrowing to changes in the value of collateral (resulting from greater leverage), resulting in larger increases in investment and economic activity from inflation shocks. Consumption of bond holders decreases, as the negative real wealth effect of the inflation shock outweighs increases in income from both expanded lending and the rising real interest rate required to bring inflation back to target. In contrast, consumption of equity holders increases strongly as their dividend income rises and their wealth increases as a result of the decline in the real value of their debt. This redistribution towards equity holders increases with financial market sophistication.⁹¹ The boost in economic activity also benefits capital holders more than labour, and this relative redistribution towards capital also increases with financial market sophistication.

70. A positive *productivity shock* makes production more efficient and hence increases dividends and asset prices (the latter reflecting the discounted value of future profits). The increase in asset prices raises the value of collateral, relaxing the credit constraint of equity holders and expanding their capacity to borrow and invest. All of this results in a large positive income gain for equity holders. In contrast, bond holders remain largely unaffected. Labour and capital income increase with stronger economic activity, but due to the positive wealth effect on capital holders from increasing asset prices the relative position of labour deteriorates.

90. In line with the results of this paper, Nolan and Thoenissen (2009) also find that financial shocks are very tightly linked with the onset of recessions.

91. Correspondingly, downward inflation or deflation shocks lead to a decrease in borrowing, investment and economic activity, and together with a negative wealth effect from rising real debt redistribute away from equity holders. The redistribution increases with financial market sophistication.

Figure 11. Financial crisis shock in the nominal bonds versus real equity model

3.2.2.2 Central bank objective function

71. A more responsive central bank that changes the policy rate more aggressively when faced with deviations of inflation from its target is found to dampen the redistributive impact of shocks.

- For example, financial crises redistribute less towards bond holders, essentially because larger policy rate cuts dampen the negative impact of financial crises on investment and growth (Figure 12). Similarly, upward inflation shocks redistribute less towards share holders, as larger rate increases mitigate the negative wealth effects on bond holders from rising inflation.
- A more responsive central bank also reduces the redistribution towards labour as a result of a financial crisis, as it softens the negative impact of the crisis on asset prices. Upward inflation shocks also redistribute less towards capital under a more responsive central bank.

Figure 12. Inflation shock in the nominal bonds versus real equity model

3.2.2.3 Labour-supply elasticity

72. Simulations of Model 2 show that a less elastic labour supply tends to reinforce the redistributive impact of shocks on labour and capital income (Figure 13). A positive productivity shock induces firms to raise production, leading to increased demand for capital and labour. If labour supply is less elastic, firms effectively substitute capital for labour by opting for larger increases in investment, and the resulting increase in asset prices reinforces the redistribution of productivity shocks from labour to capital. Similarly, a less elastic labour supply reinforces the redistributive impact of positive inflation shocks towards capital as the substitution of capital for labour increases asset prices, although only in the short term. Finally, a less elastic labour supply amplifies the relative redistribution from capital to labour caused by financial crises. This effect, which again holds only in the short term, arises because slower adjustment in the labour market results in lower investment and asset prices.

Figure 13. Productivity shock in the capital owners versus workers model

3.2.2.4 Product market regulation

73. Simulations suggest that more regulated product markets dampen the redistributive impact of the considered shocks. In more strictly regulated product markets firms increase production significantly less following a positive productivity shock (Figure 14). Hence, firms demand less new capital and labour than with more flexible product markets. The dampened increase in output results also in lower asset price increases, which in turn lowers borrowing and investment by firms. Consequently, more regulated product markets dampen the redistribution towards capital holders normally associated with productivity shocks. Similarly, in the wake of positive inflation shocks stricter product market regulation dampens redistribution towards capital holders, again reflecting smaller increases in output, asset prices, borrowing and investment. More regulated product markets also reduce the redistributive effect from financial crises towards workers by mitigating the fall in output and asset prices.

74. However, the DSGE model only allows for a static effect from PMR: simply equating stricter PMR with a higher mark-up mechanically leads to a lower elasticity of investment and hence of output to the shocks considered. In reality, stricter PMR can also prevent or slow down necessary reallocation in the aftermath of shocks (Arnold *et al.*, 2008), thereby potentially *increasing* their adverse output effects.⁹² This

92. Similarly, in reality PMR does not increase mark-ups uniformly, but rather results in particularly high mark-ups in some protected parts of the economy, with little direct effect on mark-ups for the far larger remaining part that functions in a more competitive environment. However, the more competitive sectors often have to rely on inputs from more protected sectors, potentially worsening output effects for the more competitive part of the economy in the wake of shocks, and more so the higher PMR. If larger output effects in the competitive sector outweigh dampened effects in the protected part of the economy, stricter PMR is likely to magnify output effects, and thereby redistributive effects of shocks. On the issue of downstream effects of PMR see also Bourles *et al.* (2010).

effect is not captured by the model, but may outweigh the included static effect, which would explain the empirical results presented in Section 3.1 that point to stricter PMR *increasing* the redistributive effects of adverse macroeconomic shocks.

Figure 14. Productivity shock under different degrees of product market regulation

3.2.2.5 Wage flexibility

75. Low wage flexibility amplifies the redistributive impact of all shocks. Under a financial crisis shock higher real wage rigidity increases redistribution towards workers, although both groups suffer a larger income loss in absolute terms (Figure 15). Essentially, less flexible wages amplify the negative impact on investment and growth since firms' scope for reducing production costs is limited, resulting in stronger reductions in profits and thereby larger falls in asset prices. The fall in asset prices makes the collateral constraint more binding, triggering a larger deleveraging of capital holders, which in turn worsens the economic crisis. Stronger decreases in borrowing and investment under low wage flexibility amplify the reduction in the income of capital holders. Since the response of wages is muted, the response to the crisis results in a larger drop in hours worked, thereby also affecting workers. Under a positive inflation shock, lower real wage flexibility amplifies redistribution towards capital holders. As the collateral constraint is relaxed with rising nominal asset prices, rising borrowing and investment increase labour demand. Under higher wage rigidity, this rise in labour demand results in slower wage increases, and hence a smaller increase in production costs. The increase in the income share of capital holders is magnified under real wage rigidity as the effect from slower wage increases dominates the rise in labour income that results from a stronger positive response in hours worked. In a similar vein, in the case of a positive productivity shock, lower wage flexibility – while benefiting both capital holders and workers –

redistributes in favour of capital holders. This redistribution arises in part through a similar mechanism as for the inflation shock (via increased activity through a relaxed collateral constraint etc.), but is magnified insofar as higher real wage rigidity slows down the adjustment of wages to the higher productivity level.

Figure 15. Financial crisis shock under different degrees of wage flexibility

3.3 Conclusions from the technical analysis: country models of risk sharing

76. Bringing together the results from the empirical and the model-based analyses, this section attempts to provide a rough assessment of how different countries are likely to fare in terms of macroeconomic risk-sharing, depending on their existing policies and institutions. For this purpose, Table 3 sums up the strength of some key risk-sharing institutions – defined here narrowly as those that dampen the impact of shocks on income distribution – across OECD and selected non-OECD countries. This table does not aim to classify or rank individual countries and involves some element of judgement, but it still provides some overview of the strength of different risk-sharing institutions in various groups of countries.

Table 3. Institutions facilitating income risk sharing by country

	More generous unemploy. benefits	More stringent EPL	Greater importance of minimum wages	Stronger unions	Lower tax wedge	Lower PMR	Smaller financial sector
OECD Continental Europe							
Austria	..	..	...	..	.	..	.
Belgium	..	.	..	...	.	.	..
France	...	...	...	..	.	..	..
Germany	..	...	..	..	.	..	..
Greece	.	..	..	..	..	.	..
Italy	..	..	..	..	.	..	..
Luxembourg	...	...	.	..	..	.	.
Netherlands	...	...	.	..	.	...	.
Portugal	...	...	..	..	..	..	..
Spain	...	...	.	..	..	...	.
Switzerland	...	.	..	.	...	...	.
OECD Northern Europe							
Denmark	...	.	.	...	..	...	..
Finland	...	..	..	...	..	...	..
Iceland	...	.	..	...	...	...	.
Norway	...	..	..	...	..	...	..
Sweden	...	...	..	...	.	..	..
OECD Eastern Europe							
Czech Republic	..	...	.	.	.	.	...
Estonia		..	.	.		..	...
Hungary	...	..	..	.	.	..	...
Poland	..	..	.	.	..	.	...
Slovak Republic	..	...	.	.	..	.	...
Slovenia		..	..	..		..	...
OECD English Speaking							
Australia	.	.	..	..	...	...	..
Canada	..	.	.	.	...	...	..
Ireland	..	.	..	..	...	...	.
New Zealand	.	.	...	.	...	...	..
UK	.	.	.	.	..	...	.
US	.	.	.	.	...	...	.
OECD Asia							
Japan	..	.	.	.	...	...	..
Korea	.	..	.	.	...	..	..
Other OECD							
Chile		..	.	.		.	...
Israel		..	.	..		.	..
Turkey	.	...	...	.	..	.	...
Mexico		..	.	.	...	.	...
Selected non-OECD							
Brazil		.	.	..	.	.	...
China		...	.	.		.	...
India	.	...	.	..	...	.	...
Indonesia	.	...	...	.	...		...
Russia		..	.	.		.	...
South Africa		.	..	..		.	..

#. Dots and shades of grey depict the strength of given income risk-sharing institutions, with more dots or darker shades of grey indicating more developed institutions.

77. It appears that there are two broad types of institutions that facilitate income risk sharing, namely “social-protection” and “reallocation-facilitating” institutions. Social-protection institutions include unemployment benefits, EPL, minimum wages or strong unions, whereas liberal product markets and low tax wedges are examples of risk-sharing institutions that likely work by facilitating reallocation. On this basis, four broad groups of countries can be identified: *i)* countries that provide income risk sharing mainly via social-protection institutions, *ii)* countries that rely mainly on reallocation-facilitating institutions, *iii)* countries where neither class of institutions are developed and *iv)* countries that rely strongly on both of them. In such a framework, the large majority of continental-European countries (Switzerland being the most notable exception) would be in the first group (see Figure 16 which aggregates the information from Table 3). English-speaking and Asian OECD countries would typically fall in the second group. OECD and non-OECD emerging economies would form the third group, with eastern-European countries halfway between continental Europe and the emerging economies. The fourth group would mainly consist of the Nordic countries.

Figure 16. Strength of different income risk-sharing institutions across country groups

Source: The indicator measuring the strength of reallocation-facilitating institutions is based on product market regulation and average tax wedges on labour, with lower tax wedges and more pro-competitive regulation resulting in higher indicator values. The indicator measuring the strength of social-protection institutions is based on unemployment benefits, employment protection legislation, statutory minimum wages, and the strength of trade unions, with higher values in these variables resulting in higher indicator values. Underlying variables have been normalised prior to aggregation. Data are taken from *Going for Growth 2011* and 2010.

* excluding Switzerland

78. The four models are likely to differ both in their income risk-sharing capacities and concerning possible connected costs. Social-protection institutions are typically found to amplify the adverse employment effects of shocks on certain groups at the margin of the labour market, most notably youths, whereas reallocation-facilitating institutions likely take longer than social-protection institutions to develop their full potential. Consequently, *short-term* income risk sharing may be relatively less developed in most English-speaking and Asian OECD countries. In contrast, most continental-European and (possibly to a lesser degree) eastern-European countries are likely to pay a higher degree of income protection of lower income households in the wake of negative shocks with poor labour market performance of youth and labour market outsiders more broadly. With neither class of risk-sharing institutions being well developed in OECD and non-OECD emerging economies,⁹³ and small financial sectors in these countries unlikely to

93. Even though some of these countries show relatively high levels of EPL on paper, coverage and in some cases enforcement may lead to much lower EPL in practice.

be more than very partial substitutes for this lack, households are largely left with trying to share income risk through social networks and, possibly, increased participation in the informal sector. Finally, the Nordic countries, which typically combine strong reallocation-facilitating institutions with well-developed social insurance, should provide a relatively high degree of (relative) income protection to lower-income households in the wake of adverse macroeconomic shocks, even though likely with adverse employment effects on youths. Potential problems from youth unemployment seem to have traditionally been mitigated by generous financing for education and low requirements to qualify for unemployment benefits in Nordic countries. In turn, disincentive effects may have been limited by strong activation policies and social ethic. At the same time, such a “model” probably comes with efficiency losses associated with the high costs of the benefit systems and activation policies and high marginal tax rates on the financing side, highlighting again possible trade-offs between efficiency and risk-sharing (defined here as income distribution) considerations.

79. While the various models strike different trade-offs between long-run efficiency and short-term income risk-sharing considerations, there may be room for improving the terms of this trade-off in many countries, *e.g.* by reducing the efficiency cost of certain existing insurance mechanisms. For instance, in-work benefits might protect workers against the risk of income loss at a lower employment and economic cost than high minimum wages (OECD, 2006). Moreover, some policies and institutions are actually beneficial from both a risk-sharing and an efficiency perspective, thereby providing obvious directions for reforms. Examples are short-time working schemes, relatively liberal product market regulation, and prudent fiscal policy.

80. Any attempt at finding a more favourable trade-off between efficiency and equity objectives should also recognise the existence of economic and political-economy linkages across different risk-sharing mechanisms. As one among many examples of such interactions between policies and institutions, lower taxes wedges can help strengthen the risk-sharing impact of, and alleviate any adverse employment and income effects from stronger protection of low-skilled workers’ incomes through higher minimum wages. As regards political-economy interactions, institutions that protect labour market insiders such as strict EPL for permanent workers or excess coverage of wage bargaining may be mutually reinforcing, creating “*status-quo*” bias (Saint-Paul, 2004). Likewise, strong economy-wide trade unions that are representative of all workers may strengthen political support for risk-sharing devices that benefit *both* outsiders and insiders, such as higher public spending on ALMPs (Elmeskov *et al.*, 1998). More broadly, each of the existing models may have some degree of internal coherence, making it difficult – and in some cases even unwarranted – to change certain specific policy settings in isolation. As in addition each model may reflect strong societal preferences, looking at best practice within each grouping may be a sensible alternative to all countries aspiring to the same model.

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ANNEX

81. Following a brief review of the literature that examines how various macroeconomic shocks affect different groups of individuals in a country, the annex presents in detail the methodology underlying the empirical analysis. It then presents detailed empirical results obtained for distributional effects of macroeconomic shocks on variables reflecting income and employment, both with and without institutional differences taken into account. Figures depicting the quantitative regression results are presented at the end of this annex.

A1. Literature overview

82. The amount of literature devoted to the effects of macroeconomic shocks on different population groups is highly uneven across shocks. For some macroeconomic shocks such as financial crises or migration shocks, a large body of literature exists, studying *e.g.* their distributive consequences or their labour market impact on different types of individuals. In contrast, for other types of shocks such issues have received fairly limited attention.

Financial crises and exchange rate shocks

Theoretical considerations

83. It is often claimed that the poorest sections of society suffer most from financial crises. Poor households often lack direct access to credit or asset markets, precluding them from smoothing the consumption impact of a shock. Unskilled workers may also be the first to lose their jobs as firms try to “hoard” their trained labour force (Agenor 2004a, 2004b). In addition, poor households tend to be less geographically mobile, potentially increasing the difficulty of finding jobs. They may also suffer disproportionately from inflation that, particularly in developing countries, has often accompanied financial crisis (see section 1.2). Along the same lines, a change in relative prices caused by currency depreciation typically pushes up the price of imported (and tradable domestically-produced) food, which accounts for a larger share of poorer households’ consumption.⁹⁴ Crisis-driven fiscal adjustment may include cuts in public spending and welfare payouts, potentially resulting in less redistribution towards lower income households. In low-income countries, a crisis-related deterioration in health and education for the lower-income strata may have adverse long-term effects on poverty and/or income distribution (Lustig 2000).

84. However, there are also some features that may partly insulate poorer households from the negative effects of a crisis. Lack of access to credit and goods markets largely shelters the poor from turmoil in these markets. Also, the poor may be less affected by adverse formal labour market conditions, as alternative employment possibilities in the informal sector are often more widespread for them, even though increased unemployment and real wage cuts in the formal sector are likely to add some pressure on

94. In contrast, when the poor are net producers of food, they may gain. For example, the real devaluation of the late 1980s and early 1990s in Sub-Saharan countries benefited the rural poor as they were net food producers (Sahn *et al.*, 1997). Agenor (2004b) based on a panel of developing countries, also finds empirically that exchange rate depreciation strongly reduces poverty, consistent with the view that poor farmers benefit from increasing relative prices of their tradable agricultural production.

the informal labour market as well (Morley, 1995; Manuelyan and Walton, 1998; Lustig and Walton, 1998).

Results from cross-country studies

85. A large share of the empirical literature focuses on developing countries where most of the financial crises occurred in the 1980s and 1990. Baldacci *et al.* (2002) analyse the impact of 65 financial crisis episodes in non-OECD countries between 1960 and 1998.⁹⁵ Based on macroeconomic data they find financial crises to be associated with an increase in the incidence of poverty and a widening income distribution. Negative effects are, however, not restricted to the poor, with the income of the highest quintile also falling in relative terms during financial crises. Based on a panel of 16 countries⁹⁶ over the entire 20th century, Roine *et al.* (2009) show that banking crises reduced the income share of the highest percentile (top one percent of incomes), but had no impact on the income share of the highest decile when excluding the top one percentile. Neither group was particularly affected by currency crises. Based on a sample of Latin American countries, Lustig (2000) reports that macroeconomic crises increased poverty, and in a large majority of cases also inequality.⁹⁷ Again, the poorest quintile of the population was not always hurt disproportionately: in general the income or expenditure share of the middle ranges fell most. The income share of the top decile increased in a majority of countries, in contradiction with Baldacci *et al.* (2002) and Roine *et al.* (2009).

86. In addition to immediate adverse effects on their relative income position, poor households may suffer a deterioration of their longer-term earnings prospects. In low-income countries, schooling tends to decline during a macroeconomic crisis, while by contrast in rich and middle-income countries schooling rates often increase (Ferreira and Schady, 2008). Financial crises also tend to have a negative impact on child health and mortality in low- and middle-income countries (SEEDRMAP, 2008).

87. Based on a cross-country sample of non-OECD and OECD economies, Diwan (2001; 2002) examines the impact of financial crises on income accruing to capital and labour,⁹⁸ and finds a tendency for the labour share to fall sharply during a financial crisis, recovering only partially in subsequent years.

Results from selected country-specific studies

88. Following Halac and Schmuckler (2003), financial transfers are an important channel through which financial crises can affect the income distribution. Based on a number of case studies of Latin American financial crises, they find that the fiscal cost of crisis resolution generally implies transfers from non-participants to participants of the financial sector. Moreover, these transfers benefit only a small fraction of financial-sector participants, such as large or foreign depositors, or large borrowers with close ties to banks. In contrast, small depositors typically lose out. The resulting financial transfers from poorer to richer households negatively affect the income distribution.

89. Based on microeconomic data for Mexico, both Baldacci *et al.* (2002) and Cunningham and Maloney (2000) report that inequality has fallen in the wake of the 1995 crisis, as the income share of the lowest quintile increased while that of the highest quintile fell. According to Lopez-Acevedo and Salinas (2000), this was in part caused by a disproportionately large fall in the labour income of the richest decile, only partly offset by an increase in capital income during this period. Baldacci *et al.* also report that

95. Financial crisis episodes being defined as currency devaluation of at least 25%.

96. Fourteen OECD countries plus Argentina and India.

97. Financial crises in a large sense, encompassing *e.g.* financial, liquidity, currency or debt crises.

98. Financial crisis episodes being defined as currency devaluation of at least 25%.

both homeowners and larger households were better protected from poverty, the former as they did not have to spend income on rent, the latter mainly because of the available option to raise the labour supply of some household members. Both poverty rates and the poverty gap (*i.e.* the depth of poverty) increased particularly strongly for single-parent households. In Indonesia, the 1997 crisis also led to increased poverty due to a fall in real wages rather than a decline in employment rates (see Box 1 for details). Based on Brazilian household data, Ferreira *et al.* (2004) report that the 1999 currency crisis resulted in large increases in unemployment that were similar for rural and urban workers, along with relatively larger increases in the informal economy in urban areas. The increase in both formal unemployment and informal employment was particularly large among urban workers with intermediate and high skill levels.

90. Summing up, the empirical evidence shows financial crises to increase poverty, sometimes but not always connected to an increase in inequality. The exact distributive impact across the different income and/or wealth groups is complex and differs across countries and studies, however, probably because the specificities of financial crises matter. Some studies also report disproportionately large adverse effects of financial crises for top income earners.

Inflation shocks

91. Lower-income households are particularly vulnerable to inflation as they often have less access to inflation-proof assets than their richer counterparts and typically hold a larger share of their wealth in cash. In addition, low-skilled workers may disproportionately suffer from an inflation-induced fall in real wages, as they typically have relatively little wage bargaining power and no capital income that could compensate for falling wage income.

92. Easterly and Fischer (2001) show – based on opinion polls – that poorer agents consider inflation a larger problem, and – based on macro panel data – that on average inflation increases inequality. Most microeconomic studies for specific countries come to similar conclusions. In Brazil, inflation contributed to widening inequality during the 1980s, lowering the income share of the four lowest quintiles (Ferreira and Litchfield, 1999). In India, inflationary periods have resulted in temporary increases in poverty, in terms of both incidence and depth (Datt and Ravallion, 1998). However, using a small panel of developing countries, Agenor (2004b) does not find a negative impact of inflation on poverty. In some instances inflation was used to redistribute towards the lower strata of society through inflation-tax financed fiscal transfers,⁹⁹ as during the Argentine populist periods under Peron (1946-55 and 1973-75).

Commodity price shocks

93. While a large number of studies examine the effects of commodity price booms on macroeconomic performance,¹⁰⁰ few papers look at the redistributive effects of such shocks. Positive commodity price shocks would be expected to increase the income share of the commodity-exporting sector, and through an increase in the exchange rate they may also redistribute from the (non-commodity) tradable to the non-tradable sector. The “resource curse” literature claims that commodity price booms would also lead to a decline of the manufacturing sector through the so-called “Dutch disease” effect. However, while there are cases where discoveries of commodities were followed by declines in manufacturing, there is little systematic empirical evidence for this claim – *e.g.* Spatafora and Warner (1995) find that in oil-exporting countries agriculture and manufacturing did *not* contract in reaction to oil price increases.

99. See Easterly and Fischer (2001) for references.

100. See *e.g.* van der Ploeg (2010) for a survey of the “resource curse” literature, as well as Lederman and Maloney (2008) for recent evidence that the resource curse does not exist.

94. In commodity-importing countries, the share of commodities such as agricultural products or oil in total consumption is – at least for most OECD countries – typically larger for lower incomes. For this reason, commodity price shocks have been found to have a bigger negative impact on consumption at the bottom of the income distribution (see *e.g.* Essama-Nsah *et al.*, 2007, for country-specific evidence). This is consistent with Agenor (2004b) who finds that terms-of-trade improvements significantly lower poverty. Polgreen and Silos (2006) present evidence for the United States that oil price shocks benefit unskilled workers as the skill premium and oil prices tend to fluctuate in opposite directions. For Australia, Bhattacharyya and Williamson (2009) present evidence that the income share of the top percentile increased considerably with large positive commodity price shocks, returning to previous levels when temporary commodity price increases unwound.¹⁰¹

Fiscal shocks

95. Fiscal packages can in principle be designed in many different ways, and fiscal consolidations or expansions do not necessarily imply a particular distributional impact. In developing countries, cuts in public spending often take the form of a reduction in public sector employment,¹⁰² public goods provision or transfers. Spending cuts may therefore disproportionately affect the poor if they are more reliant on such redistributive practices (Lanjouw and Ravallion, 1999).¹⁰³ Cardoso (1992) and Morley (1995) indeed suggest that fiscal stabilisation in Brazil worsened poverty by reducing social expenditures. Based on a panel of OECD and non-OECD countries over 40 years, Lopez (2003) shows that a decrease in the size of government has been associated with increased inequality, also pointing to potential regressive effects from fiscal adjustments. Similarly, Roine *et al.* (2009) show that increased central government expenditures raise the income share of the nine lowest deciles. Interestingly, however, changes in government expenditures appear not to affect the top one percentile. Based on macroeconomic data for OECD countries, Dahan and Strawczynski (2010) claim that fiscal rules lead to disproportional cuts in social expenditures that result in increased inequality.

96. Jensen and Rutherford (2002) use a Dynamic General Equilibrium Model to simulate the impact of fiscal tightening in the context of debt reduction. They show that if public goods are relatively more valuable to the poor, the elderly poor stand to lose most from public debt reduction achieved through spending cuts as they suffer from the scaling-down of public services without the prospect of any future benefits. However, for the poor as a group, the immediate drop in consumption can be compensated in the future due to increased public spending possibilities from savings on debt servicing. If reduced debt service requirements are instead used to cut progressive wage taxes, future benefits are largest for rich individuals.

Productivity / Technology shocks

97. The literature on productivity/technology shocks usually focuses on their economy-wide macroeconomic effects rather than their distributive impact. However, the example of the industrial and information technology (IT) revolutions would suggest that technology shocks result in an initial increase in inequality (see Box A1), with the former example suggesting that inequality subsequently declines. The initial rise in inequality arises as technology shocks are skill-biased, *i.e.* they benefit skilled workers more than non-skilled ones, and create new profit opportunities that increase returns on investments.

101. This could be due to the top percentile owning a large share of Australian natural resource companies.

102. For example Bourguignon and Morrison (1992) report that the fiscal adjustment in Cote d'Ivoire in the early 1980s was accompanied by massive layoffs in the public sector, affecting mainly unskilled and young workers.

103. There is, however, also evidence that in developing countries social expenditure may disproportionately benefit upper-income households (Camargo and Ferreira 2000).

Box A1. Technology shocks: the industrial and information technology revolution

Permanent productivity shocks mostly occur in the form of technological innovations and are often reflected in new durable goods and/or services.¹ Prices of such new products decline sharply as productivity increases. As skills facilitate the adoption of new technologies, and technological progress is likely to be biased towards more skill-intensive production, the income of skilled workers would be expected to increase relative to unskilled ones (see e.g. Greenwood and Yorukoglu, 1997). In addition, the wealthy stand to benefit more than the poor from technological progress in the short run since the introduction of new technologies may lead to new profit opportunities for investors and increased asset prices. As a result, inequality is likely to increase. Given that older people typically own more capital than younger ones, Autor *et al.* (1998) speculate that they may benefit more from improved investment opportunities. Young individuals may, however, adjust more quickly to new technologies, which may improve their relative position with respect to the older generation in labour markets.

While it is difficult to determine empirically the impact of technology shocks on different agents' income as changes are spread over long periods, it would seem that both the industrial and the more recent IT revolutions have been characterised by an initial increase in income inequality. In both instances, the demand for skilled labour and the skill premium rose (see Autor *et al.*, 1998). At the beginning of the industrial revolution, falling real wages were accompanied by rising real returns to capital (Lindert and Williamson, 1985). Ultimately, however, the industrial revolution led to a reduction of income inequalities within societies, even though it increased them between societies in a process labelled the Great Divergence (see e.g. Clark 2007 or Pomeranz 2000). Initial increases in inequality were subsequently reversed as productivity increases were more widely shared.² When new technologies become more established, the skills required to operate them decline, and younger workers can gradually be better trained. The combination of a shift in labour demand towards unskilled workers with an increase in the supply of skilled workers may have decreased the skill premium, *ceteris paribus* (see e.g. Greenwood and Yorukoglu, 1997). One open issue is whether the more recent IT revolution will eventually produce similar effects.

1. Gali (1999) identifies technological innovation as the only productivity shocks that can have a permanent impact on productivity and output.
2. Galor and Moav (2004) even argue that inequality was beneficial for the industrial revolution in its initial stages, when accumulation of physical capital was crucial.

Capital stock shocks

98. While most capital stock shocks result from destruction brought about by natural disasters, not all natural disasters can be qualified as capital stock shocks. Earthquakes and storms, for example, are more likely to result in a large destruction of physical capital than for example droughts. Also, if natural disasters affect only a small part of a country, impacts on the aggregate capital stock may be relatively small so that no macroeconomic effects may be discernible beyond the regional level. A different example of negative capital stock shock is German reunification which, by imposing wages close to West-German levels in the eastern part of the country, rendered the overwhelming part of the existing East-German productive capital stock effectively worthless overnight (see e.g. Akerlof *et al.*, 1991). In contrast, the ensuing massive investment in East Germany in the wake of reunification has been interpreted as a positive capital stock shock (Burda, 2006).

99. There is little, if any, empirical evidence on the distributive effects of capital stock shocks. Based on a large panel of OECD and non-OECD countries, Loyaza *et al.* (2009) show that different types of natural disasters had dissimilar impacts on growth: smaller shocks produced both positive – possibly through the need for reconstruction investment – and negative growth effects, whereas larger shocks had

only negative ones. They speculate that lower strata of society may be comparatively less affected by earthquakes and storms to the extent that they result in labour intensive reconstruction efforts.¹⁰⁴

Demographic shifts

100. Demographic shifts result from changes in fertility, mortality or migration. While mortality developments are typically gradual and predictable, developments with respect to fertility and migration may sometimes be unforeseen and abrupt. Insofar as demographic developments are gradual and predictable, they do not strictly qualify as shocks and are qualitatively different in nature from other shocks under consideration in this paper. Longevity risk – defined as the risk that life expectancy forecasts suddenly turn out to be erroneous as new data become available – is a more standard type of shock, however. It is by definition unpredictable, and can have dramatic immediate impacts *e.g.* on the solvability of insurance companies. With the main paper focusing on genuine shocks, the literature survey presented in this annex also briefly discusses the distributive impact of more gradual demographic changes.

Fertility and mortality developments

101. Zamac (2005) explores the distributive effects across different generations of a rise in fertility, using a general equilibrium model with overlapping generations. He shows that the distributive effects of a fertility shock vary substantially as a function of the assumed intergenerational transfer scheme. For example, the lifetime consumption of a baby-boom generation increases in the presence of a social transfer scheme, but decreases otherwise. In the absence of a transfer scheme, a (positive) fertility shock will put pressure on the education system, but result in a medium-term gain for the pension system.¹⁰⁵ Antolin (2007) and Visco (2006) argue that both private sector companies with pension liabilities, as well as governments are exposed to significant longevity risk, not least as the quality and timeliness of available mortality data is weak, and official mortality projections may underestimate increases in average life duration.

Migration shocks

102. Basic economic theory suggests that immigration shocks initially reduce the income of wage earners *vis-à-vis* capital owners before the capital stock gradually adjusts and these distributive effects are reversed. If there are barriers to downward wage adjustments, immigration may instead increase unemployment. Differences in skills between immigrants and natives are also likely to influence relative wages (*i.e.* skill premiums) in the host country with low-skilled immigration typically increasing income inequality at least in the short term.

103. A wide body of empirical literature surveyed in previous OECD work (Jean *et al.*, 2007) studies the wage and employment effects of immigration. Summarising the main findings of the literature as well as on the basis of own analysis, Jean *et al.* (2007) report that immigration influences relative wages with effects depending on the skill mix of immigrants, with pressures at the aggregate level typically limited and vanishing after a few years. Immigration of workers with a given level of skills and experience does not appear to have much impact on the unemployment rate of natives with similar characteristics. By contrast, immigrants underperform natives in terms of wages and/or unemployment, and particularly for unemployment this effect is found to be highly persistent. Immigrant students also perform significantly

104. In contrast, following Loyaza *et al.* (2009) the poor in developing countries may suffer disproportionately from storms insofar as these have particularly negative effects on agricultural output to which they are especially sensitive (see Christiansen and Demery, 2007).

105. For further details on demographic transitions see also Batini *et al.* (2006), Hagemann and Nicoletti (1989) or Auerbach and Kotlikoff (1985).

worse than their native counterparts. Migration may therefore affect the income distribution in the short run, and even more persistently as regards the relative income position of immigrants and their offspring.

A2. Methodology of empirical analysis

Methodologies for constructing the different macroeconomic shocks

104. Identifying macroeconomic shocks is not a straightforward task. In the stylised world of most theoretical models, a shock is an exogenous event affecting an economy in equilibrium state. In reality it is hard to infer the degree of exogeneity of observed events, and a systematic approach for identifying exogenous shocks, such as *e.g.* by estimating series of VARs for multiple individual shocks and a large number of countries, is beyond the scope of this paper. For this reason, shocks are identified here with a more straightforward empirical method. A shock is simply defined as a sufficiently large movement in a given variable over a certain period. In particular, the change over time in the underlying continuous variable (*e.g.* commodity prices for commodity price shocks) is compared against the overall sample variation across countries and time. A dummy variable is then constructed that takes value 1 when movements exceed a certain number of standard deviations and 0 otherwise.¹⁰⁶ Three dummy variables are constructed for each of the underlying variables, corresponding to three alternative stringency criteria, for example 1.5, 2 or 2.5 standard deviations in the case of yearly changes, and the results presented in this annex have been checked for robustness against applying different stringency criteria.

105. Shock variables are defined separately for positive and negative shocks to allow for possible asymmetric effects of opposite shocks. Restricting the effects of shocks in both directions to be equal would imply a possibly unwarranted loss of generality, and there are reasons to believe that, for example, the distributional implications of exchange rate appreciations and depreciations may not simply mirror each other. Indeed, symmetric effects are rarely found in the present analysis. The use of different stringency criteria and of separate variables for positive and negative shocks is also useful because the sample variation may be influenced by long-run trends in some of the underlying variables. Such trends could make it more or less difficult for a given movement in the variable to qualify as a shock on a single criterion, depending on whether that change is in line with or goes against the trend.

106. In addition to an analysis based on yearly changes in the underlying macroeconomic variables, an alternative approach is undertaken as a robustness check. This approach looks at 5-year windows and compares the maximum cumulative movement of the underlying variables against the overall sample variation, again with different stringency criteria applied (2.5, 3 and 3.5 standard deviations in this case). The idea behind this robustness check is that some variables tend to move slowly, so that yearly changes alone might miss some historic shocks that have taken the form of several smaller movements into the same direction over several consecutive years. One example may be changes in the structural fiscal balance, with consolidation often achieved over several years.

107. Using the above-mentioned methods, shocks are defined for exchange rates, commodity prices, inflation, interest rates and the fiscal stance,¹⁰⁷ while for financial crises a definition based on existing literature has been used:

106. This transformation into a binary variable also drastically reduces the potential econometric issues arising from the fact that some of the underlying macroeconomic variables are estimated, such as interest rates or fiscal balances.

107. The impact of fiscal shocks on various groups (*e.g.* low- versus high-income households) can be expected to vary depending on the type of tax and spending items affected. Therefore, shocks to the fiscal stance may be qualitatively different from the other examined shocks insofar as they are not only shocks to the economy, but also potentially to different types of risk-sharing mechanisms themselves.

- *Exchange rate shocks* are identified based on changes in real effective exchange rates calculated by the OECD. These in turn are constructed as weighted averages of real exchange rates across trading partners and goods traded.
- *Commodity price shocks* are identified on the basis of movements in each country's commodity terms-of-trade, where different commodities are weighted by their relative importance for each country. The subsequent econometric analysis distinguishes between net commodity importers and net commodity exporters, because the economic mechanisms at play may in principle differ across these two groups of countries.
- *Fiscal consolidation and expansion shocks* are derived from changes in the residuals of a regression of structural fiscal balances on the output gap, so as to control for the possibility of remaining endogenous, business cycle-driven changes in structural fiscal positions. The impact of fiscal shocks on various groups (e.g. low- versus high-income households) can be expected to vary depending on the type of tax and spending items affected, which in turn may have varied over time and across countries. Therefore, shocks to the fiscal stance may be qualitatively different from the other examined shocks insofar as they are not only shocks to the economy, but also potentially to different types of risk-sharing mechanisms themselves.
- *Interest rate shocks* are considered with respect to both short-term policy rates and long rates. For the identification of short-term rate shocks, standard monetary policy reactions to cyclical or inflation developments are removed by using residuals obtained by estimating Taylor rules. While this remains an imperfect approach, it by and large ensures that shocks are not picking up normal business cycle-driven policy reactions.
- *Inflation and disinflation shocks* are constructed from changes in consumer price inflation rates. In order to account for the trend decline in inflation over the sample period, the relevant standard deviation used here for any given year is an average of the standard deviation over the entire sample and a ten-year rolling window. No sufficiently robust results regarding the distributional impact of inflation or disinflation shocks, or an interaction with institutions, could be found, although disinflation shocks are found to affect current account balances in the last section of this annex. The lack of distributional results may be due to the fact that inflation shocks can have different origins (e.g. being driven by supply- or demand-side factors) that would be expected to have dissimilar distributive implications. While the literature provides some empirical evidence that very high inflation has been detrimental to poorer segments of society,¹⁰⁸ more recent panel analysis has failed to find such a systematic distributive effect¹⁰⁹. All in all, while the experience of some countries points to large redistributive effects from some inflationary episodes,¹¹⁰ effects may vary strongly with the source and magnitude of the shock and may therefore not be detectible with the systematic approach taken here.
- *Financial crises* are defined as in Reinhart and Rogoff (2009), who compile a database of banking crises across the world going back more than a century. They identify banking crises on the basis of either bank runs that lead to the closure, merging, or takeover by the public sector of one or more financial institutions or – if there are no runs – the closure, merging, or takeover of, or large-scale

108. See Easterly and Fischer (2001).

109. See Agenor (2004).

110. See e.g. Ferreira and Litchfield (1999), Datt and Ravallion (1998), or the literature on the inflation during the Weimar Republic for historic examples.

government assistance to an important financial institution that marks the start of a string of similar outcomes for other financial institutions.

108. In principle, identifying shocks on the basis of large changes in the underlying variables carries a risk that some of them may in fact capture endogenous responses to other “genuine” shocks (*e.g.* the monetary policy shock variable might reflect some response to *e.g.* commodity price shocks). In practice, however, pair-wise correlations between different types of shocks are low, both for simultaneous and lagged correlations. The largest correlation (0.15) is observed between the dummy variables that capture shocks to short and long term interest rates, which comes as no surprise as long rates would be expected to reflect to some degree shocks to short rates. Similar but even lower correlations are also observed between financial crises and negative exchange rate shocks, and between positive interest rate and disinflation shocks. Moreover, the standard deviation criterion used to identify the shocks makes their identification relatively robust to normal fluctuations in the underlying macroeconomic variables. Since only large changes are scored as one, it is highly likely that the identified events have a strong “genuine” shock component even when some of the changes in the macroeconomic variables considered are not fully exogenous. To rule out that possible business-cycle effects influence the analytical findings, a further robustness check is undertaken in which the output gap is directly controlled for by adding it to the set of explanatory variables. This does not affect the qualitative results.

Measuring differential effects across population groups and institutions: data issues

109. Macroeconomic shocks can have distributional effects along a number of dimensions. The scope of what can be analysed, however, is severely constrained by the availability of data. The empirical analysis presented here focuses on selected aspects, including income and wealth inequality, differential effects on population groups with different educational attainments, and differential effects on various age groups.

110. Income inequality can be measured in different ways, including GINI coefficients as a general measure for inequality across the entire income distribution, or by using more detailed information on the shares of income accruing to each quintile of the income distribution. This information is compiled from several sources, including the World Income Inequality Database (UNU-WIDER, 2008, based in part on Deininger and Squire, 1996), the OECD (Förster and Mira d’Ercole, 2005) and the International Labour Organisation (ILO, 2010). Given the focus on the sharing of risk, income shares by quintile reflect the relative position of these population groups rather than their absolute income, and the analysis reports the relative impacts of shocks for the different groups rather than the absolute effects. In addition to these data on inequality, relative poverty rates are compiled based on World Bank (2008) to focus on the bottom end of income distributions. These relative poverty rates are defined as the percentage of people with an income below 50% of median income.

111. Panel data on the distribution of income by educational attainment or age are not readily available, and had to be constructed from the Luxembourg Income Study (LIS), a collection of household survey data from several countries based on national sources. While in principle the basic unit of analysis can be either the individual or the household, data on financial variables is often only available at the household level, implying that these indicators are constructed at the household level. For individual characteristics such as age or educational attainment, the characteristics of the household head – generally the person with the highest income within a household – have been chosen to represent the household. The constructed indicators compare the disposable income of various household groups, for example one indicator compares the income of households with completed secondary education to the income of those without. Another indicator relates the disposable income of households with completed university education (or specialised vocational education or a doctorate degree) to the income of households without completed secondary education. For age, a similar procedure is applied, dividing households into five age

groups (the 18-25, 26-35, 35-55, 56-65 and 65+ years old), where the average income of each age group is divided by the average income of the reference age group 35-55. The resulting unbalanced panel data for education and age are available for 21 countries with a limited time dimension, spanning from 1979 to 2004 in the best case. Furthermore, the household data are used to construct a measure of the disposable income of households that receive significant amounts of income from capital (*i.e.* the top third of households with respect to capital income) relative to the income of the remaining households, as well as a measure for the income of home-owners relative to that of tenants. In practice, some of these groups show some overlap.

112. The labour market performance of groups with different age or education levels is analysed on the basis of employment and unemployment data from the International Labour Organisation (ILO, 2010). These data feature 5-year age groups starting with the 20-24 and ending with the 60-64 age group, while the breakdown by educational groups includes five different levels of educational attainment. For each of these groups, in order to examine whether a given group was affected more or less than the average the difference between the group-specific and the aggregate employment or unemployment rate is used.

113. Finally, the analysis seeks to understand how a number of institutional features shape the differential effects of macroeconomic shocks within an economy. For this analysis, a wide range of institutional variables are considered covering issues like the size of the state, the generosity of welfare spending, the structure of the tax system, labour market institutions, financial development, the exchange rate system, the quality of legal framework conditions, product market regulation, international openness, and the human capital of the labour force. Table A1 presents a full list of the institutional variables used in the analysis.

The empirical framework for the income and employment analysis

114. A simple dynamic regression framework is used to explore the impact of macroeconomic shocks on the various income and employment variables. Dynamic models, which include several lags of the dependent variable as explanatory variables, allow an analysis of changes in the distribution of income across different household groups without requiring the construction of a fully-fledged structural model of the steady-state determinants of this distribution.¹¹¹ In a comparable context, Cerra and Saxena (2009) and Furceri and Mourougane (2009a; 2009b) apply an autoregressive estimation technique to analyse the effects of financial crises on GDP growth. However, as so-called impulse-response functions are calculated recursively, this approach has been criticised for being sensitive to small specification or estimation errors that always exist in practice. Based on Jorda (2005); Teulings and Zubanov (2009) therefore suggest a related estimation technique in which the coefficients of the impulse response function are estimated directly for each time horizon, thus making the method more robust. This approach, which has also been applied in recent OECD work (Duval *et al.*, 2010), is pursued in the present analysis. In order to obtain estimates for the effects of the different shocks and for how these shocks interact with different institutional settings, shocks and institutions are added into the regression framework as interaction terms. In particular, five equations are estimated for each of the five years following the occurrence of a shock, where an example equation for the year immediately after the shock ($t+1$) takes the form:

$$Y_{it+1} - Y_{it} = \alpha + \sum_{j=0}^3 \beta_j \Delta Y_{it-j} + \gamma_1 SHOCK_{it} + \delta_1 SHOCK_{it} * INST_{it} + \varepsilon_1 INST_{it} + \bar{\theta} \cdot \overline{COVAR}_{it} + \mu_t + \eta_{it}$$

115. In this set of equations, Y_{it} measures the distributional variable of interest. The focus is on the coefficients γ and δ that measure the response of the distributional variable to the shock in interaction with

111. While the analysis accounts for changes in the relative situation of a given group, it abstracts from possible transitions of given individuals between groups.

different institutional settings, looking one to five years into the future from the year of occurrence of a macroeconomic shock. The parameter estimates for γ and δ are used to calculate marginal effects of the shock variable for a high level (66th percentile) and a low level (33rd percentile) of the institutional variable, for each of the five years. Additional regressors in the equation include three years of lagged differences, time fixed effects μ_t , and a set of covariates (covar) that control for country differences including population, GDP per capita, a time-varying measure of remoteness based on market potential, the foreign asset position, a measure of geographical remoteness¹¹² and the share of commodity exports in a country's total exports. In practice, the inclusion of the covariates does not appear to affect the qualitative results. The lagged difference terms may or may not be included, and in fact Teulings and Zubanov (2009) use specifications with and without these terms. Even though robustness checks indicate that the inclusion of these lagged differences does not affect the results strongly, they are retained to control for a maximum of unobserved influences that are not related to macroeconomic shocks.

116. Although country fixed effects are not explicitly present in this estimation equation, the dependent variable is in differences which removes the effect of all constant country differences in the level of that variable. Further adding country fixed effects into the estimation equation above would remove the influences of country-specific trends in the dependent variable, but in the context of time spans with a maximum of five years the practical relevance of controlling for intrinsic trends in the distributional variables may be limited. Furthermore, country fixed effects could not be included in some of the institutional analysis because they would be collinear with many of the institutional variables whose time variation is either zero or very small. Robustness checks that have been undertaken in a few cases where the time dimension of the institutional variable allowed an inclusion of country fixed effects (unemployment benefits, EPL) suggest that the results obtained are qualitatively comparable whether or not country fixed effects were included.

117. While the presence of a lagged dependent variable and a first-differenced equation may in principle bias the estimation of the β coefficients in short samples (Nickell, 1981), the length of the time dimension (around 30 years of data) mitigates any possible concerns about such bias, given that the finite sample bias is of the order of $1/T$, where T is the length of the time dimension (see *e.g.* Greene, 2000, Section 14.7 or Angrist and Pischke, 2009, Section 5.3 for reference).

118. Finally, given potential measurement errors in some of the dependent and institutional variables and the unbalanced nature of the estimation sample, the estimation equations are systematically checked for strong outliers using Cook's D , and extreme outliers are removed in order to make the estimations more stable. Standard errors are clustered to allow for possible error correlations at the country level.

119. Figures depicting the quantitative regression results are presented at the end of this annex. To make the presentation of the results of the interaction specifications more intuitive, the estimated marginal effects of macroeconomic shocks under different institutional settings are depicted in floating bar charts (Figures A1 to A79) in which the boundaries of the bars depict the marginal effects when an institutional variable is either high or low. In these figures, statistically significant effects are indicated by solid floating columns, while effects that are not statistically significant are indicated instead by a light dotted floating column. Stars on the horizontal axis indicate the level of statistical significance, following the conventional notation of 1, 2 and 3 stars for statistical significance at the 10, 5, and 1% levels, respectively.

112. This measure has been taken from Boulhol *et al.* (2008).

A3. Empirical results for income and employment effects

Financial crisis shocks

120. Financial crises have been found to reduce the income share of the highest income quintile to the benefit of the upper middle classes, although the latter have gained only in relative but not in absolute terms. One possible explanation for the particularly strong negative effect on top incomes may be that sectors with high wage bills (e.g. banking) may be particularly hard hit by financial crises. Another factor is that capital income – which is concentrated in the higher-income strata – may be particularly vulnerable to financial shocks. At the other end of the income scale, poverty rates have tended to rise in the aftermath of financial crises. These results are presented in Table A2.

121. Institutions have affected the distributional effects of financial shocks in several ways. The negative effect on the incomes of high-income earners relative to the average has been amplified by more generous unemployment benefits (Figure A1), possibly because lower incomes are better protected against losses from unemployment spells where unemployment benefits provide a stronger cushion. Higher financial development has also amplified the negative effect on the highest income quintile (Figure A2), which may be due to the higher pre-crisis leverage of capital holders in more developed financial markets. Stricter employment protection legislation (EPL) has amplified the shift in the income distribution from the edges towards the middle classes, in particular towards the fourth quintile (Figure A3). Increases in poverty rates appear to have been dampened where first-year unemployment benefits were higher (Figure A4) and where product markets were more flexible (Figure A5).

122. Negative effects on youth employment have been amplified by more generous unemployment benefits (especially for the first year of the unemployment spell), higher tax wedges, stricter EPL and more developed financial markets (Figures A6-9).¹¹³ Also, youth unemployment rose more than aggregate unemployment in countries with a wider reach of minimum wage regulations, stronger trade unions (as measured by union density, the coverage of collective bargaining agreements or its excess coverage over union density), more centralised wage bargaining, stricter product market regulation and higher FDI restrictions (Figures A10-14). Prime age workers in their 40s and 50s, by contrast, have generally been less affected by financial crises than other age groups, and this has been especially the case where unions were stronger and where employment protection legislation was more stringent (Figures A15-16). The incomes of seniors (the 55-65 age group) have been reduced less strongly by financial crises where unemployment benefits were more generous (Figure A17). Finally, individuals with below tertiary education have suffered from particularly strong employment losses where the duration of unemployment benefits was longer (Figure A18). Also, there is some evidence that women's employment rates have taken a larger hit than men's, in particular where financial markets were more developed (Figure A19).

Fiscal consolidations and expansions

123. Strong fiscal consolidations are found to have reduced the income share of the bottom quintile of the income distribution, while fiscal expansions have generally reduced income inequality and poverty. Insofar as social transfers were cut during past fiscal consolidations, low-income households may have been particularly affected. Similarly, public programmes aimed at helping the needy may be better funded during times of fiscal expansions. Although the aforementioned empirical findings are roughly in line with the scarce literature on the subject, it should be kept in mind that fiscal packages can be designed in many

113. This may reflect that financial crises may be more disruptive in countries with more developed financial systems, which in turn has particular negative effects on youths (and labour market outsiders more broadly, see the impact on female employment rates below).

different ways, and fiscal consolidations or expansions do not *a priori* imply a particular distributional impact.

124. The adverse impact of fiscal adjustments on low-income earners appears to have been dampened by more developed welfare systems and EPL (Figures A20-21). In addition, adverse effects on poverty and the income share of the poor seem to have been mitigated where public institutions were less affected by corruption (Figure A22). The analysis also suggests that the second-lowest income quintile has benefitted from a more comprehensive minimum wage system in the aftermath of fiscal consolidations (Figure A23). In contrast, more comprehensive minimum wage rules, stronger labour unions (as measured by the excess coverage of wage bargaining or by union density), or less openness to international trade (Figures A24-26) have deteriorated youth labour market outcomes. By contrast, stronger unions have reduced the relative unemployment of prime age individuals (Figure A27 for the age group 40-44 using union density, with similar results obtained for coverage and excess coverage of collective wage bargaining). Unemployment among older age groups has increased more where unemployment benefits were long-lasting (Figure A28), suggesting that some of the elderly that became unemployed during fiscal consolidations *de facto* pre-retired.

125. Following fiscal expansions, reductions in (relative) poverty have generally been larger under more progressive income tax systems and more flexible product markets (Figures A29-30). By contrast, more centralised wage bargaining systems have dampened increases in the income share of the poor (Q1 and Q2), while similarly dampening losses for high income earners (Q5, see Figures A31-32). Youths have enjoyed larger relative income gains after fiscal expansions under more developed welfare systems, and experienced larger unemployment declines under generous unemployment benefits (Figures A33-34). Older workers have seen their unemployment rates fall more under stricter EPL, while a lower effective retirement age has dampened the increase in their income share (Figures A35-36).

Exchange rate shocks

126. Devaluation shocks are found to have increased income inequality, whereas sharp currency appreciations have reduced it by benefitting lower incomes and harming higher ones. Since currency appreciations are likely to reduce profits in tradable sectors, it is conceivable that the resulting reductions in capital income from these sectors would result in larger adverse income effects in the top income ranges. The finding that appreciations mainly benefit poorer households is consistent with studies highlighting the political popularity of exchange rate appreciations.¹¹⁴

127. Turning to interactions with institutions, there is some evidence that inequality has tended to increase more where the banking sector or the stock market was more developed (Figures A37-38). Likewise, more credit (relative to domestic income) has decreased the income shares of the two bottom quintiles (Figure A39). Greater openness to capital flows amplified increases in inequality, while stronger unions limited them (Figures A40-42). Currency appreciation shocks – which have generally reduced inequality – have increased the income share of the lowest quintile of the distribution, in particular where unions were stronger (Figure A43).

128. Looking at differences in labour market performance across age groups after devaluations, (relative) youth labour market outcomes deteriorated more in countries with stronger unions, more centralised wage bargaining systems, higher unemployment benefits and tax wedges, more stringent EPL, a wider reach of minimum wage regulations and stricter PMR (Figures A44-49). In contrast, higher openness to international trade has improved the labour market performance of youths after devaluation shocks by reducing youth unemployment (Figure A50). Unemployment rates of older workers have usually

114. See e.g. Bahmani-Oskooee (1997) or Carvalho Filho and Chamon (2008).

increased more where tax wedges and unemployment benefits were high, minimum wage regulations had a wider reach, unions were stronger (measured by union density, coverage and excess coverage of collective bargaining), and in economies that were more open to international trade (Figures A51-53). In contrast, older workers have fared better in the labour market where EPL was more stringent, while prime age workers have benefitted from stronger unions (measured by the coverage of collective bargaining and union density).

Interest rate shocks

129. Upward short-term interest rate shocks appear to have decreased inequality by raising the income share of the three bottom quintiles to the detriment of the highest quintile.¹¹⁵ Similarly, interest rate shocks have decreased the income share of households with high capital income. A possible explanation could be that wealth holdings of those with high capital income contain larger shares of assets (such as stocks) whose returns usually suffer from higher interest rates, whereas other households hold larger shares of deposits whose returns may increase with interest rates.

130. The (relative) incomes of the lowest quintile have generally risen more where unemployment benefits were more generous, particularly in the first year of an unemployment spell (Figure A54). Greater openness to trade has also amplified the positive income share effect of interest rate hikes for the two bottom quintiles, as well as the negative effect on the top quintile (Figures A55-56), which together resulted in decreasing inequality. Higher banking sector development and stricter EPL have also exacerbated a negative effect on high capital income earners (Figures A57-58). In contrast, more liberal financial account regimes have dampened the income gains of the two bottom quintiles and the losses of the top quintile (Figures A59-60). Reductions in inequality after interest rate hikes were also lower where tax wedges were high (Figure A61).

131. Turning to the labour market, unemployment rates of youths have increased more in the wake of upward interest rate shocks where unemployment benefits and tax wedges were higher, the reach of minimum wage regulations was wider, unions were stronger and product market regulation was more stringent (Figures A62-66). By contrast, trade openness has mitigated the deterioration in youth labour market performance (Figure A67). In line with the effects on youth unemployment, several institutions have dampened the (relative) income gains of youths after interest rate shocks, including higher tax wedges, stronger unions, stricter PMR and more stringent EPL (Figures A68-71).

Commodity price shocks

132. The analysis points to significant adverse effects of (upward) commodity-price shocks on poorer parts of society, both through a decline in the share of income accruing to the two bottom-income quintiles and an increase in poverty. These findings hold for both net commodity importers and exporters, and may reflect the general tendency for poor households -who typically have a below-average level of education- to be the first to suffer job losses as activity declines. The income losses experienced by low-income households in the face of commodity-price hikes may be a particular concern because they come on top of a reduction in their relative purchasing power, because commodity products (*e.g.* gasoline or energy) typically account for a larger share of their expenditures. Commodity-price shocks also reduce the income share of those with high capital income, possibly reflecting shrinking profits as firms face rising costs for commodity-related inputs.

115. Interest rate shocks being defined as policy rate increases far beyond what a simple monetary policy rule would have required.

133. As concerns institutional characteristics, in (net) commodity-importing countries commodity price hikes have reduced the income share of high capital income earners particularly where the reach of statutory minimum wages and the coverage of collective wage agreements was higher (Figures A72-73). High human capital was by contrast a mitigating factor (Figure A74). Youth unemployment has risen more where minimum wages were higher, their reach was wider and where unions were stronger (Figure A75-76).

A4. Empirical results for effects on current account balances

134. Turning to risk sharing across countries, a macro-data based analysis of the extent to which shocks affect a country's current account balance suggests that countries hit by negative shock mitigate the impact by partly exporting the costs to their trading partners. The empirical framework used for this analysis is exactly the same as described in Section 3.1.1, except that the dependent variable is now countries' current account balances one to five years after the occurrence of a given shock.

135. A number of significant empirical findings emerge. First, as expected, currency depreciation shocks have improved and appreciation shocks have deteriorated the current account (Figures A77-78). Also, in line with expectations, rising (falling) commodity terms of trade have improved (deteriorated) the current account balance (Figures A79-80).

136. Fiscal consolidation shocks are found to have quite sizeable current account effects, most likely because of their positive impact on total domestic saving. Five-year episodes of fiscal consolidation, corresponding to an average improvement in the cyclically-adjusted fiscal balance of slightly over 7 percentage points, have on average triggered overall improvements in the current account of almost 3 percentage points (Figure A81).¹¹⁶ These effects are broadly in line with recent IMF estimates by Abbas *et al.* (2010) and with recent OECD work by Kerdrain *et al.*, 2010.

137. Similarly, disinflation shocks have improved current accounts (Figure A82). Provided that nominal exchange rate adjustment is slow and/or incomplete, as is likely under fixed exchange rate regimes, disinflation improves the international competitiveness of domestic goods and services and thereby the trade balance.¹¹⁷ Finally, financial crises are also found to improve the current account balance (Figure A83), most likely *via* a reduction in import demand. The economic significance of this effect is somewhat weaker than for the other shocks mentioned above, however.

116. However, it should be noted that these effects are estimated all else equal, so that history provides little guidance as to the effects of fiscal consolidation in a situation where a large number of countries would consolidate simultaneously.

117. Indeed, this effect is driven by the subsample of countries with fixed exchange rate regimes.

Table A1. Variables used in the institutional analysis

Institution	Description of Variables	Source
Size of government	Tax and social security contributions as a percentage of GDP.	OECD, Annual National Accounts Database
Direct tax wedge	Sum of personal income tax and employee plus employer social security contributions together with any payroll tax less cash transfers, expressed as a percentage of labour costs.	OECD, Taxing Wages Database
Consumption tax	Consumption tax revenue as a percentage of total tax revenue.	OECD, Annual National Accounts Database
Tax progressivity	Obtained by comparing the marginal personal income tax rate (excluding social security contributions) with the average personal income tax rate for a single worker at the APW wage.	Johansson <i>et al.</i> (2008)
Developed welfare system	General government transfers and subsidies as a percentage of GDP.	Fraser Institute, EFW
Policies promoting female participation	Tax incentives to work part-time (increase in household disposable income between a situation where the husband earns the entire household income, and a situation where husband and wife share earnings respectively, for a couple with two children).	OECD Benefits and Wages
Fiscal federalism	Degree of fiscal federalism: state + local revenues as percentage of total government revenues.	OECD Regional Statistics
Unemployment benefits	Average replacement rates: Average gross unemployment benefit replacement rates over two earnings levels, three family situations and three durations of unemployment.	OECD Benefits and Wages
	First year replacement rates: initial unemployment benefits replacement rates.	OECD Benefits and Wages
	Duration of unemployment benefits — ratio of average replacement rate over 5-year unemployment spell and average replacement rate during first year of unemployment spell.	OECD Benefits and Wages, Bassanini and Duval 2006
EPL	Strictness of overall employment protection.	OECD, Employment Database
Minimum wages	Level of minimum wages: minimum wage as share of median wage.	OECD Benefits and Wages
	Reach of minimum wage legislation: 4=minimum wage fixed by an authority; 3=by collective agreement (large coverage), 2=by collective agreement (low coverage), 1=dual system.	ILO, Minimum Wage Database
Strength of trade unions	Union density: percentage share of workers affiliated to a trade union.	OECD Labour Force Statistics
	Collective bargaining coverage: percentage share of workers covered by a collective agreement.	OECD Employment Outlook 2004
	Excess coverage of collective bargaining systems, defined as coverage of collective bargaining system minus union density.	OECD calculations
	Number of strikes and lockouts, by economic activity.	ILO, LABORSTA
	Days not worked per 1,000 workers.	ILO, LABORSTA
Centralisation of wage bargaining	Dominant level of bargaining: 1 = firm level, 2 = firm/industry, 3 = industry level, 4 = industry/central level, 5 = central level.	OECD Employment Outlook 2004
Early retirement	Average effective retirement age.	OECD Labour Force Statistics
Product market regulation	Indicator measuring the degree to which policies promote or inhibit competition in areas of the product market where competition is viable.	OECD, Product Market Regulation Database
Openness of economies	FDI regulatory restrictiveness index.	OECD
	Actual size trade sector relative to expected (as estimated with gravity model).	Fraser Institute, EFW
	Capital flow restrictions: different types of international capital controls.	IMF, Annual EAER Report
Financial development	Credit by the financial sector to households and private non-financial institutions as share of GDP.	WB, Financial Development and Structure (FDS) Database
	Stock market development: Principal component calculated using capitalisation of and value traded on the stock market (both as share of GDP).	OECD calculations; WB FDS Database
	Total banking capital and reserves as share of GDP.	OECD Banking Statistics
	Total banking assets as share of GDP.	OECD Banking Statistics
Exch. rate regime	Index for <i>de facto</i> exchange-rate regime.	Levy-Yeyati and Sturzenegger
Government Effectiveness	Indicator for government effectiveness.	WB, Worldwide Governance Indicators (WGI)
Rule of Law	Indicator for rule of law.	WB, WGI
Corruption	Index for freedom from corruption.	International Country Risk Guide, ADB Institute
Level of human capital	Index of human capital: average years of schooling weighted by quality of secondary education (proxied by recent PISA scores).	OECD, Education at a Glance

Table A2. Regression results on impacts of shocks without interactions

Dependent variable	Year after shock (p-values in parentheses)				
	1	2	3	4	5
Financial shocks have reduced the income share of the highest income quintile					
Income share of the 5th quintile of the income distribution, in percentage points	-0.52 ** (0.01)	-0.32 (0.31)	-0.24 (0.56)	-0.29 (0.53)	-0.13 (0.82)
Financial shocks have increased the relative income of the 3rd and 4th quintiles					
Income share of the 3rd quintile of the income distribution, in percentage points	0.08 ** (0.03)	0.08 (0.18)	0.08 (0.31)	0.14 (0.13)	0.05 (0.60)
Income share of the 4th quintile of the income distribution, in percentage points	0.17 *** (0.00)	0.11 (0.12)	0.08 (0.35)	0.23 ** (0.01)	0.08 (0.46)
Financial shocks have increased poverty					
Poverty rate in percentage points	0.11 ** (0.02)	0.19 ** (0.04)	0.27 * (0.07)	0.34 * (0.09)	0.44 * (0.09)
Fiscal contractions have hurt the lowest income quintile					
Income share of the 1st quintile of the income distribution, in percentage points	-0.01 (0.90)	-0.24 ** (0.05)	-0.24 (0.13)	-0.56 *** (0.00)	-0.65 *** (0.00)
Fiscal expansions have reduced income inequality					
GINI coefficient	-0.61 *** (0.01)	-0.73 ** (0.02)	-0.74 * (0.06)	-0.81 * (0.09)	-0.69 (0.20)
Fiscal expansions have reduced poverty					
Poverty rate in percentage points	-0.13 ** (0.03)	-0.27 ** (0.03)	-0.40 ** (0.04)	-0.56 ** (0.04)	-0.78 ** (0.03)
Currency devaluations have increased income inequality					
GINI coefficient	0.81 ** (0.01)	0.76 * (0.07)	0.54 * (0.08)	1.07 ** (0.03)	1.81 *** (0.00)
Currency appreciations have decreased income inequality					
Income share of the 1st quintile of the income distribution, in percentage points	0.30 ** (0.02)	0.53 *** (0.00)	0.95 *** (0.00)	0.84 *** (0.00)	0.94 *** (0.00)
Income share of the 2nd quintile of the income distribution, in percentage points	0.40 *** (0.00)	0.55 *** (0.00)	0.55 ** (0.02)	0.29 (0.15)	-0.16 (0.72)
Income share of the 5th quintile of the income distribution, in percentage points	-0.52 ** (0.01)	-0.32 (0.31)	-0.24 (0.56)	-0.29 (0.53)	-0.13 (0.82)
Interest rate hikes have decreased income inequality					
Income share of the 1st quintile of the income distribution, in percentage points	0.31 *** (0.01)	0.60 *** (0.00)	0.48 * (0.06)	1.06 *** (0.00)	0.87 ** (0.02)
Income share of the 2nd quintile of the income distribution, in percentage points	0.22 *** (0.00)	0.81 *** (0.00)	0.77 *** (0.00)	0.66 ** (0.01)	0.89 *** (0.01)
Income share of the 3rd quintile of the income distribution, in percentage points	0.19 (0.20)	0.73 *** (0.00)	0.81 *** (0.00)	0.60 *** (0.00)	0.50 *** (0.00)
Income share of the 5th quintile of the income distribution, in percentage points	-0.51 *** (0.00)	-1.48 *** (0.00)	-1.51 ** (0.01)	-1.51 ** (0.02)	-1.07 (0.27)
Income of those with large capital receipts, relative to those without	0.05 (0.43)	-0.38 ** (0.01)	-0.68 *** (0.00)	-1.58 *** (0.00)	-0.53 *** (0.00)
Upward commodity shocks have hurt low income households					
Poverty rate in percentage points	0.32 (0.19)	0.79 * (0.10)	1.90 *** (0.01)	2.71 *** (0.01)	3.61 *** (0.00)
Income share of the 1st quintile of the income distribution, in percentage points	-0.15 * (0.07)	-0.30 ** (0.02)	-0.32 ** (0.05)	-0.41 ** (0.04)	-0.41 * (0.07)
Income share of the 2nd quintile of the income distribution, in percentage points	-0.24 ** (0.01)	-0.30 ** (0.04)	-0.29 * (0.10)	-0.37 * (0.07)	-0.36 (0.13)
Upward commodity shocks have hurt households with large capital incomes					
Income of households with large capital incomes, relative to other households	-0.04 *** (0.00)	-0.08 *** (0.00)	-0.09 ** (0.03)	-0.07 ** (0.03)	-0.09 ** (0.02)

*, **, *** indicate statistical significance at the 10, 5 and 1 percent levels, respectively.

Figure A1. Change in income share of Q5 following financial crises
Interaction with institution: Replacement rates of unemployment benefits

Figure A2. Change in income share of Q5 following financial crises
Interaction with institution: Banking sector development
(Total banking assets/GDP)

Figure A3. Change in income share of Q4 following financial crises
Interaction with institution: EPL

Figure A4. Change in poverty following financial crises
Interaction with institution: Replacement rates of unemployment benefits, first year

Figure A5. Change in poverty following financial crises
Interaction with institution: PMR

Figure A6. Change in youth employment rates (20-24) following financial crises (net of aggregate employment changes)
Interaction with institution: Replacement rates of unemployment benefits, first year

Figure A7. Change in youth employment rates (20-24) following financial crises (net of aggregate employment changes)
Interaction with institution: Tax wedge

Figure A8. Change in youth employment rates (20-24) following financial crises (net of aggregate employment changes)
Interaction with institution: EPL

Figure A9. Change in youth employment rates (20-24) following financial crises (net of aggregate employment changes)
Interaction with institution: Financial development
(Total banking capital and reserves/GDP)

Figure A10. Change in youth unemployment rates (25-29) following financial crises (net of aggregate unemployment changes)
Interaction with institution: Reach of statutory minimum wage legislation

Figure A11. Change in youth unemployment rates (20-24) following financial crises (net of aggregate unemployment changes)
Interaction with institution: Union density

Figure A12. Change in youth unemployment rates (20-24) following financial crises (net of aggregate unemployment changes)
Interaction with institution: Centralisation of wage bargaining

Figure A13. Change in youth unemployment rates (20-24) following financial crises (net of aggregate unemployment changes)
Interaction with institution: PMR

Figure A14. Change in youth unemployment rates (20-24) following financial crises (net of aggregate unemployment changes)
Interaction with institution: FDI restrictions

Figure A15. Change in unemployment rates of prime age workers aged 50-54 following financial crises (net of aggregate unemployment changes)
Interaction with institution: Union density

Figure A16. Change in unemployment rates of workers aged 50-54 following financial crises (net of aggregate unemployment changes)
Interaction with institution: EPL

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