ECONOMIC BULLETIN

SPRING | 2011

Volume 17, Number 1

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ISSUE FOR DISCUSSION I

MONETARY POLICY AND FINANCIAL STABILITY: AN OPEN
DEBATE

MONETARY POLICY AND FINANCIAL STABILITY: AN OPEN DEBATE*

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ABSTRACT

The recent global financial crisis triggered the need to better understand the link between the financial sector and the macroeconomy and the role of central banks in addressing financial stability concerns, in particular regarding the interaction with monetary policy. This paper surveys the main contributions from the economic literature on this issue. There is a wide set of perspectives on how monetary policy should take into account financial stability. Proposals range from strengthening the understanding and monitoring of macro-financial interactions to more drastic ones that propose to add financial stability as an additional objective for monetary policy or use monetary policy for financial stability purposes. We conclude that given the importance of the financial system for the monetary policy transmission mechanism, financial stability concerns need to be taken into account in monetary policy. On the other hand, monetary policy, including unconventional measures, contributes to financial stability (it is even crucial to it under certain circumstances). However, the monetary policy primary objective should remain focused on price stability. It should also be noted that, in general, price stability does not guarantee financial stability and potential conflits between the two are highly unfavourable. Therefore, it is essential for other policies, in particular micro and macro-prudential ones, to maintain a close surveillance of the financial system and, whenever needed, act to reduce the likelihood of systemic events and minimize the negative effects on the economy.

I.   Introduction

The financial turmoil that started in the summer of 2007 turned into a severe global economic and financial crisis. The crisis made it apparent that monetary stability does not guarantee financial stability and that financial liberalisation and innovation imply that finance plays a bigger role in macroeconomic dynamics than previously thought. The recent developments triggered the need to better understand the link between the financial sector and the macroeconomy. It also reignited the debate on how to rethink the role of central banks in addressing financial stability concerns, in particular regarding the interaction with monetary policy, both in "normal" and in crisis periods. The purpose of this article is to discuss this issue by conducting a survey of the relevant literature.

Before analysing the interaction between financial stability and monetary policy, first it is necessary to clarify what is meant by both concepts. This is particularly the case for "financial stability", which is difficult to define. Schinasi (2004) emphasises that the concept of financial stability is broad, encompassing the role of financial infrastructure (legal system, financial regulation, supervision and surveillance), institutions and markets. According to Schinasi, a stable financial system should be "capable of facilitating

(rather than impeding) the performance of an economy and of dissipating financial imbalances that arise endogenously or as a result of significant adverse and unanticipated events". We will take this definition as our reference for the meaning of financial stability.

Monetary policy, in turn, can be seen as the institutional arrangements and the use of the monetary authority instruments in order to maximise social welfare. The usual monetary policy instrument is a short-term interest rate, which is set using open market operations and other procedures that are part of the central bank operational framework. The current dominant view is that, in normal times, the liquidity management of the central bank is not part of the monetary policy stance and the interest rate is the single instrument. However, in crisis periods, the central bank can use liquidity management actively, or make other changes to its balance sheet, that can have effects on the economy beyond the interest rate. Such measures are frequently called non-standard monetary policy measures.

Similarly to financial stability, monetary policy has several dimensions and also involves financial infrastructure, institutions and markets. In order for monetary policy to be effectively conducted, the central bank needs to have a great deal of influence on money market interest rates and changes in such rates need to be transmitted to the rest of the economy. An unstable financial system would hamper the transmission mechanism of monetary policy. Beyond the setting of interest rates, the broad monetary policy implementation framework has also important implications for the financial system. Indeed, operational aspects, such as liquidity management, the collateral framework and the counterparties of monetary policy, influence the decisions of financial intermediaries and, consequently, financial stability, as has been clearly illustrated in the recent financial crisis. Finally, communication can also be seen as a monetary policy tool which may influence financial stability through its impact on agents' expectations.

The above definitions highlight the clear interactions between monetary policy and financial stability. In this article, we analyse these by first examining the implications of financial (in)stability for the monetary policy strategy, in particular regarding the question of if and how to react to asset prices and financial imbalances. Secondly, we review the relevance of the financial system for the monetary policy transmission mechanism. Thirdly, we look at the impact of financial instability on the monetary policy implementation. Finally, we briefly discuss the future role of macro-prudential policy and its interaction with monetary policy.

II. Implications of financial (in)stability for monetary policy

II.1. Implications for the monetary policy strategy

The monetary policy strategy should take into account issues related to financial stability. However, there is no consensus in the literature and among practitioners regarding the best way to do this. One important point in this context is how to deal with asset price bubbles or misalignments. In particular, should the monetary authority address this issue ex post or ex ante and which elements of the monetary policy strategy framework should (if any) be modified to integrate financial and asset price stability issues (for example should they be taken into account in the monetary policy goals or in policy rules). Several perspectives have been proposed in the literature.

II.1.1. Asset prices in the price index objective

A simple approach to take into account asset price movements in monetary policy is to include asset prices in the price index that constitutes the objective of the central bank. If the central bank reaches its price objective then, as a corollary, also the objective of avoiding disruptive asset price movements would be achieved. This view is based on the pioneering research on the theory of inflation measure-

ment by Alchian and Klein (1973) who focused on "a lifetime cost of living" index as the relevant one from a welfare perspective. A lifetime cost of living includes not only the prices of goods purchased in a particular year but also expected prices of future purchases.

The need to include prices of expected future purchases, which are very difficult to measure, renders this concept impractical. Nevertheless, some authors argue that asset prices contain information about future price developments and so could be used as proxies of expected goods prices. Goodhart and Hoffmann (2000, 2002) and Goodhart (2001) proposed to replace conventional inflation measures such as the CPI with a broader measure that includes housing and stock market prices with the argument that asset prices help to predict future consumer price inflation. Monetary policy would target an inflation measure that is given by a weighted sum of conventionally measured inflation and asset price inflation:

$$ \pi = \alpha \pi^{CPI} + (1-\alpha)\pi^{AP} $$

where α is the weight on the conventional inflation measure $\left(\pi^{CPI}\right)$ and $\left(1-\alpha\right)$ the weight on asset price inflation $\left(\pi^{AP}\right)$. The use of this broader measure of inflation as a monetary policy target implies that strong asset price increases could prompt tighter monetary policy even if conventionally measured inflation was low and stable.

This approach has been thoroughly debated in the academic and empirical literature and several problems have been identified.[1] First, the relationship between asset price inflation and consumer price inflation is somewhat imprecise. In particular, asset prices changes are not only related to inflation expectations but are also driven inter alia by changes in fundamentals. Second, targeting asset prices might create moral hazard problems as it might increase risk-taking by private agents in anticipation of monetary policy reactions to stabilise asset prices. Third, with rational forward-looking private agents, there is the problem of "inflation indeterminacy" which is the possibility of a circular relationship between monetary policy and asset prices: asset prices would partly determine monetary policy, while simultaneously expected future monetary policy determines today's asset prices. Fourth, if the central bank targets CPI inflation, taking into account all indicators of inflationary pressure including signals from asset prices, targeting asset prices directly would amount to double-counting inflationary pressure derived from asset prices. Fifth, the weight assigned to asset prices in a combined price index is ambiguous. Sixth, central banks lack sufficient control of asset prices as in the long run asset prices are driven by fundamental factors and not by monetary policy. Finally, empirical analysis finds little evidence that including asset prices in an inflation target measure would reliably improve economic outcomes.[2]

II.1.2. The "benign neglect" approach to asset prices

The so-called "benign neglect" approach claims that monetary policy should focus on its primary objectives – inflation (and economic growth/employment) – and that financial stability can either be addressed by the self discipline of the markets or by prudential regulation. Maintaining low and stable inflation was seen as the main contribution monetary policy could make to financial stability. Asset prices should only be considered to the extent that they may signal potential inflationary or deflationary forces. On analytical grounds this approach was supported by the work of Bernanke and Gertler (2001), who simulated different policy rules in a small scale macro model and showed theoretically and empirically that in case of a strong commitment to stabilizing expected inflation, it is neither necessary nor desirable for monetary policy to respond to changes in asset prices, except to the extent that they help to forecast inflationary or deflationary pressures. In this context it was widely accepted that the monetary

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1 A summary of the main problems is presented in Box 4 of ECB (2005).
2 See for example Filardo (2000) for the US case.

authorities should take into account information from asset prices in their assessment of the current state of the economy and in the forecasting exercises.[3]

Some experts consider that the benign neglect view was prevalent at the Fed before the financial crisis. This view rests on three main arguments (Kohn, 2006). First, it is difficult to clearly identify an asset price boom. Second, the official interest rate is considered not to be adequate to counteract asset price booms as the required increases in the interest rate may be too large and could destabilise the economy. Third, there is the conviction that when bubbles burst the effects on economic activity can be easily counteracted through lower interest rates. Notice that this policy is only possible if the required interest rate does not reach the zero lower bound. Underlying this approach is the belief in the efficiency of financial markets to auto-correct imbalances. Potential systemic risks from financial market imperfections such as informational frictions, moral hazard and herding behaviour tend to be considered of second order importance compared to the cost of pricking the bubble. This type of asymmetric policy got to be known as the "Greenspan put", by which the Federal Reserve did not react to the build up of financial imbalances and responded aggressively when bubbles burst:

> *"We at the Federal Reserve considered a number of issues related to asset bubbles – that is, surges in prices of assets to unsustainable levels. As events evolved, we recognized that, despite our suspicions, it was very difficult to definitively identify a bubble until after the fact – that is, when it's bursting confirmed its existence. Moreover, it was far from obvious that bubbles, even if identified early, could be pre-empted short of the central bank inducing a substantial contraction in economic activity – the very outcome we would be seeking to avoid. Such data suggest that nothing short of a sharp increase in short-term rates that engenders a significant economic retrenchment is sufficient to check a nascent bubble. Instead, we noted in the previously cited mid-1999 congressional testimony the need to focus on policies to mitigate the fallout when it occurs and, hopefully, ease the transition to the next expansion." – Greenspan (2002).*

This strategy of "mop up after" the burst worked well in 2000-2002 when the dot.com bubble imploded, giving rise to the idea that it would also be successful in the future when other bubbles burst (Blinder and Reis, 2005). However, the recent financial crisis showed that bubbles are not alike as some are more problematic than others. In particular, bubbles that when burst erode the balance sheets of financial intermediaries are likely to have more significant economic effects and contribute further to financial instability (Mishkin, 2008). This led to a re-examination of the Fed's position regarding this approach, but not to significant changes yet. In this context, FOMC members, while recognising that monetary policy could be used with financial stability objectives, continue to defend an approach closer to "benign neglect" as monetary policy is still considered to be too blunt a tool. Instead, the use of other instruments appears to be preferable, in particular prudential regulation:

> *"Given the bluntness of monetary policy as a tool for addressing developments that could lead to financial instability, given the side effects of using policy for this purpose (including the likely increase in variability of inflation and economic activity over the medium term), and given the need for timely policy action to realize greater benefits than costs in leaning against potential speculative excesses, my preference at this time is to use prudential regulation and supervision to strengthen the financial system and lean against developing financial imbalances." – Kohn (2010).*

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3 However, some argued that due to the high volatility of asset prices their relative weight in central bank monitoring should be small compared to other indicators.

II.1.3. The "leaning against the wind" approach

Another view that has gained increased sympathy in light of the recent financial crisis is the so-called "leaning against the wind" of asset price bubbles. The proponents of this approach argue that monetary policy should be used to contain or reduce an asset price bubble. In particular, monetary policy should be tightened in face of an inflating asset market even if near-term inflation pressures are not apparent (Cecchetti *et al.*, 2000, 2003, Borio and White, 2003). The motivation for such a policy would be to limit the build-up of significant asset price misalignments and the size of the eventual correction, thereby lowering the medium-term downside risks for the economy. Underlying this framework is the assumption of non-linear effects of asset price shocks: large shocks would have a comparatively higher impact on the economy than small/medium shocks (Stiglitz, 2009).

One of the main criticisms of "leaning against the wind" regards the difficulty in setting a clear criterium for determining asset price misalignments, defined as deviations from a level consistent with fundamentals. Those supporting the approach claim, however, that there is no need to determine with accuracy the degree of deviation from the fundamental value of individual assets and that it is a combination of developments that should raise concern.

A second criticism concerns the identification of the timing of the burst and the severity of the eventual crisis. The challenge for policy makers becomes then to discriminate ex-ante between asset price booms that are likely to end up in major economic disruptions and the ones that may not. The IMF (2010) points out that episodes of asset price upswings, where leverage and financial intermediaries involvement is significant ,tend to deflate with major economic disruptions since there is an interaction between the deterioration of borrowers and lenders balance sheet. Rising asset prices increase collateral value and thus funding liquidity, which finances further purchases and additional price increases, further intensifying the cycle. Moreover, the larger the duration of a boom episode, the greater the likelihood of it resulting in a crisis.

A third criticism relates to the uncertainty about the impact of monetary policy on bubbles. While there is significant evidence supporting that monetary policy has an effect on asset prices, results are scarce on the ability of monetary policy to have an impact on the path of a bubble. Bean *et al.* (2010) provide some tentative evidence for the US and the UK on how an aggressive "leaning against the wind" policy over 2003-2006 would have moderated the credit/asset price boom in these countries. They concluded that while this type of policy would have been effective in dampening real house price inflation, the impact on real credit growth would have been relatively limited and as such it would not be possible to conclude that this policy would have had a major impact on the probability of a crisis materialising. Posen (2006) argues that the connection between monetary conditions and the rise of bubbles is rather tenuous given that bubbles by definition are not based on fundamentals but "animal spirits". It has also been frequently claimed that, to have an impact on the path of a bubble the interest rates hike must be of a magnitude that would severely damage the economy (Blinder and Reis, 2005 and Assenmacher-Wesche and Gerlach, 2010).

The proponents of "leaning against the wind" counterargue that the impact of monetary policy on asset prices is increased if additional monetary policy transmission channels are taken into consideration, namely the "risk-taking" channel.[4] Moreover, it is claimed that credible statements by monetary authorities of concern and determination to act could influence economic agents behaviour and moderate excesses in banking and credit markets and therefore on asset prices and spending (White, 2009). Indeed, an important channel of influence over asset prices that should not be overlooked is that of communication regarding monetary policy. Recent studies (Lambertini *et al.*, 2010) show that fluctuations in expectations regarding monetary policy can lead to boom-bust cycles in asset prices. In

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4 See section II.2 of this article.

particular, Lambertini *et al*. (2010) find that unfulfilled expectations of future reductions of the monetary policy rate or of a rise in the inflation target lead to a boom-bust behaviour in most macroeconomic variables. Therefore, central banks should follow a clear and transparent communication policy when dealing with the markets and should avoid, as much as possible, monetary policy surprises, in particular those suggesting that monetary conditions will remain loose as this seems to create the right breeding ground for asset price imbalances.

Different interpretations of "leaning against the wind"

There seem to be two slightly different interpretations of the exact meaning of "leaning against the wind". One is that policy makers should take into account developments in asset prices and credit when assessing risks to price stability, thereby implicitly leaning against asset price imbalances. Another view is to understand leaning against the wind as keeping interest rates higher than warranted by risks to price stability if there is evidence of an asset price misalignment.

Among monetary authorities, the ECB has shown some support for the "leaning against the wind" approach viewed as a means of addressing risks to price stability (Trichet, 2005, 2010, ECB, 2005, 2010). Already from its inception, the ECB has stated that it attributes a more prominent role to financial variables than other central banks. This is particularly evidenced by having the monetary analysis pillar side by side with the economic analysis one. In fact, the ECB has frequently emphasized that its monetary policy strategy was designed to take into account asset price developments and potential misalignments in the context of the monetary pillar:

> «*Responding to monetary and credit dynamics as part of a comprehensive assessment of the risks to price stability in the medium-term implies that interest rate decisions will tend to "lean against" accumulating financial imbalances and asset price misalignments*» – Trichet (2010).

Thus, from the beginning the ECB has monitored very closely the developments in money and credit. Nevertheless, it should also be recognised that the ECB monetary analysis has evolved over time. In the first years of the euro, monetary analysis was primarily based on concepts derived from the quantity theory of money and the emphasis was more on monetary growth rather than on financial imbalances or misalignments. Over time, however, this analysis has been broadened and deepened, recognising the need to have an encompassing view of the financial system to better monitor the risks to price stability stemming from monetary and credit developments and to cross-check the economic analysis pillar.

It should be noted that the ECB does not clearly endorse the second view on "leaning against the wind", *i.e.*, that monetary policy should be over-tightened in face of an inflating asset market (Cecchetti *et al*., 2000, 2003, Borio and White, 2003) or should be used to fight illiquidity (Diamond and Rajan, 2009).[5] Instead, the ECB recognises that in certain circumstances a trade-off between short-term price volatility and long-term price stability may occur, but the monetary policy response should be guided by the longer run risks to price stability (ECB, 2010).

Implications for monetary policy frameworks

To make the approach of "leaning against the wind" operational some refinements in the monetary policy frameworks have been proposed. In particular, such an approach requires some tools to timely

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5 Diamond and Rajan (2009) suggest that when the short-term interest rate is at a low level, banks have an incentive to finance more illiquid projects than desirable. The opposite occurs with a high interest rate. Therefore, to counteract these incentives, the central bank should signal a future increase in the interest rate when it is at a low level and a future cut when it is at an elevated level.

detect asset price misalignments or other financial imbalances. This could be based on the early warning system literature that grounds on empirical regularities of Kaminsky *et al*. (1998) and Kaminsky and Reinhart (1999). For instance, Reinhart and Rogoff (2009), Borio and Zhu (2008) and IMF (2009) present examples of early warning indicators of banking crisis: (i) deviation from trend of real exchange rate; (ii) percentage change of real housing prices;[6] (iii) market risk indicators, such as the risk premium (which can be assessed on the basis of interest rate spreads or market volatility indicators, for example); (iv) percentage change of real stock prices; (v) short-term capital inflows in percentage of GDP, current account balance in percentage of investment and international investment position.

This "signals approach" is a systematic exercise to deliver information as to whether an economy is showing one or more of the classic symptoms that emerge before a financial crisis. According to Reinhart and Rogoff (2009) the massive borrowing by the US from the rest of the world prior to the financial crisis should have been seen as a critical warning signal. The main constraint to the success of this approach is claimed to be the fact that policy makers and market participants may treat signals as irrelevant or outdated, assuming in particular that old rules of valuation no longer apply. In addition, in some cases policy makers may be reluctant to react due to the difficulty in predicting the timing of the crisis and the fact that they may be averse to commit type II errors (*i.e.* to react on a signal that turns out to be false).

II.2. Implications of financial instability for the monetary policy transmission mechanism

As illustrated by the recent financial crisis, developments in financial markets have very significant effects on the overall economy. Given the pivotal role of the financial system, a breakdown in financial stability can disrupt the monetary policy transmission mechanism and so needs to be appropriately taken into account in order for the central bank to achieve its goals. On the other hand, monetary policy is not fully neutral from a financial stability perspective.

Chart 1[7] shows a very simplified representation of the monetary policy transmission mechanism. The transmission mechanism of monetary policy takes place through different channels, affecting different markets and variables that ultimately affect aggregate output and prices.

In a first stage, policy actions, taken on the basis of the respective monetary policy strategy, directly influence economic agents' expectations and the way these are formed. They also directly influence the financial system (financial intermediaries, financial markets and the way they interact) which is also influenced by economic agents' expectations.

The policy action triggers the necessary adjustments in the financial system that are then reflected in a set of variables that characterise monetary and financial conditions, such as asset prices, interest rates, money and credit, the exchange rate and volatility measures. These variables, together with agents' expectations, determine consumers and firms' behaviour and balance sheets, and the aggregate outcomes in terms of inflation, output and employment. Note that there are feedback mechanisms between the financial system and the non-financial sector which may amplify shocks. Finally, changes in economic activity, employment, inflation and inflation expectations feed back into policy decisions framed by the monetary policy strategy.

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[6]   Altunbas *et al*. (2009) find out that in the European Union and in the US, developments in housing prices prior to the crisis appear to have contributed to bank risk-taking. An inflation-adjusted house price growth rate that is 1 percentage point above its long-run average for six consecutive years leading up to the crisis increases the probability of default of the average bank by 1.5 per cent. This result is in line with the view that the housing market had a substantial role in the crisis and that banking distress was typically more severe in countries that experienced a more pronounced boom-bust cycle in house prices.

[7]   This diagram was built with the input of Vítor Gaspar.

Chart 1

THE MONETARY POLICY TRANSMISSION MECHANISM
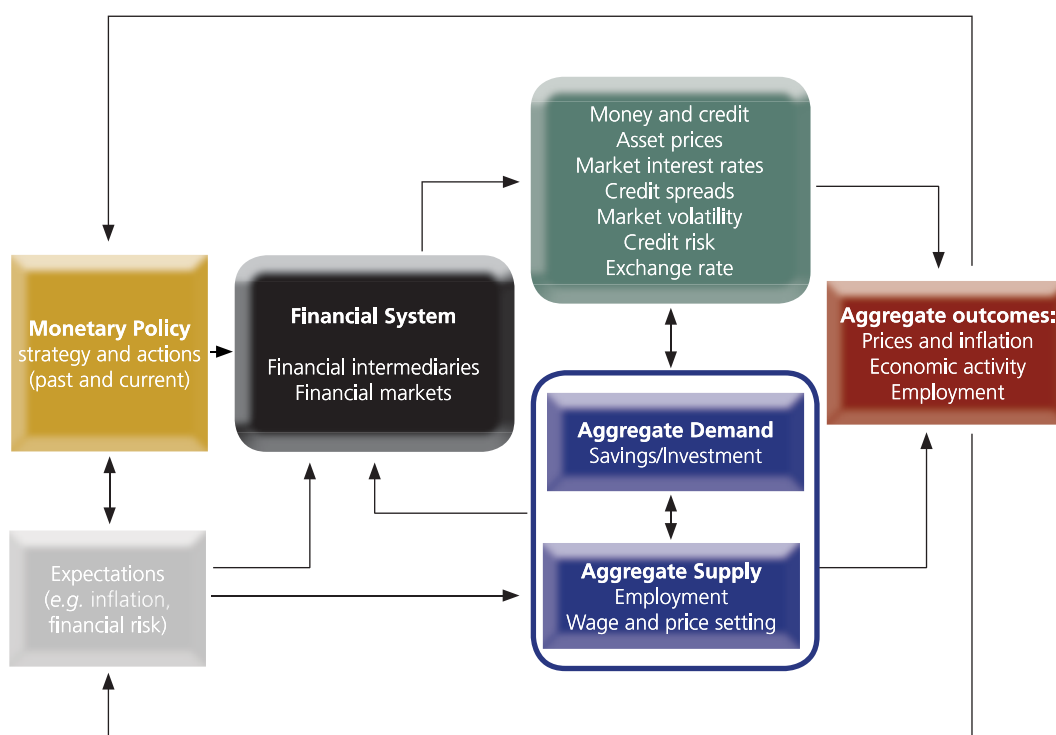
The recent literature has emphasised the increased importance of some monetary policy channels - such as the credit and the interest rate channels – and has also identified new channels – namely the risk-taking channel. Understanding the monetary policy transmission mechanism in an encompassing way is thus of utmost importance to develop frameworks that better take into account financial stability concerns.

Credit channel

The credit channel is one of the channels of monetary transmission that depends on a well functioning financial system to propagate central bank interest rate policy. One can identify two main elements of the credit channel on the transmission of monetary policy to the rest of the economy: the bank lending channel and the balance sheet channel. The former focuses on the impact of monetary policy on the quantity of credit which banks can provide to borrowers while the latter focuses on the impact of monetary policy on the financing ability of borrowers.

The bank lending channel is centered on the impact of monetary policy decisions on banks' balance sheet and their credit supply. The 'traditional' view relies on quantity-induced effects of policy and the concept of the money multiplier. A loosening of monetary policy via an expansion in bank reserves would raise deposits and, consequently, the amount of bank loans. With financial innovation and banking deregulation in the last decades, the effect of this channel has been weakening. However, in situations of financial fragility, such as during the recent crisis, quantitative effects of monetary policy operations may again play a role (see section II.3).

The theoretical framework of the balance sheet channel typically grounds on the financial accelerator mechanism (Bernanke and Gertler, 1989, 1995). This framework defines the "external finance premium" as the difference between the cost to a borrower of raising funds externally and the opportunity cost of internal funds. The external finance premium is generally positive due to market frictions and depends inversely on the borrower's net worth, defined as the sum of the firm's internal funds (liquid assets) and the collateral value of its illiquid assets. A deterioration of the borrower's balance sheet position raises the external finance premium, making borrowing more costly, reducing investment and overall economic activity. This last result is at the center of the financial accelerator. To the extent that negative shocks to the economy (for instance, a monetary policy contraction) reduce the net worth of borrowers (or positive shocks increase net worth), the spending and production effects of the initial shock will be amplified, creating a channel through which otherwise short lived monetary, real productivity shocks and problems in the financial sector may have long and lasting effects. An additional perspective, more focused more on households, is related to the existence of credit constraint which depend on the value of the collateral (Kiyotaki and Moore, 1997). In these models, shocks (productivity, for example) impact on asset prices, which impact households' credit ability, amplifying the initial effect.

Traditionally, the balance sheet channel focuses on non-financial firms' credit constraints. More recently, the literature has focused on similar effects occurring on financial intermediaries' balance sheet. Disyatat (2010) considers it the revised bank lending channel, since it impacts the ability of credit institutions in providing credit to the non-financial sector. Banks are credit constrained since they cannot expand their balance sheet indefinitely without increasing costs. First, because there are restrictions brought about by the need to comply with regulatory capital requirements. Second, because banks' (and other institutions providing loans) lenders demand an external finance premium which is negatively related to the banks' capital cushion (Disyatat, 2010, Bernanke, 2007).

Financial instability can influence the power of the credit channel of monetary policy, significantly increasing the external finance premium, both of financial intermediaries and of non-financial firms. When the disturbances are on the financial sector, monetary policy actions, namely an easing in interest rates, might have a reduced impact on the non-financial sector, as financial institutions may need to tighten credit conditions to shield their balance sheet position, thereby "absorbing" the impact of the monetary policy easing. By contrast, if the financial system is working properly and the problems affect only the non-financial sector, then a monetary policy easing will have a stronger effect on the economy than in normal times as it will tend to reduce collateral constraints.

Interest rate channel

The interest rate channel operates through the impact of official interest rate changes on real interest rates relevant for household and corporate spending and saving decisions. A decline in the real interest rate reduces the incentives for households to save and so consumption will tend to increase. At the same time, the real cost of capital declines which stimulates investment spending by corporations. This channel emphasises in particular the medium to long-term real interest rates, which are viewed as having the main impact on spending.

Financial instability may have several consequences in the functioning of this channel. To start with, financial instability may make it more difficult for the monetary authority to influence market interest rates. If these are distorted by risk premia, the central bank will find it harder to fix money market rates at the level it considers as appropriate. Furthermore, in order for this channel to be effective it is also necessary that a tightening or loosening of monetary policy is reflected in the prices of financial assets (bonds, equities, foreign exchange). For instance, a cut in interest rates should lead to changes in real interest rates, to a reduction of the incentives for households to save and to lower borrowing costs. These movements then should stimulate consumption, investment or purchases of durable goods and

housing. However, financial instability could lead to a higher level of precautionary savings thereby reducing the effectiveness of monetary policy. Similarly, if asset prices are volatile then their reaction to changes in the central bank's interest rates will be more difficult to predict thereby disturbing the wealth effects of monetary policy.

Risk taking channel

According to recent contributions, the risk perception and tolerance of economic agents may change in the context of benign economic and financial conditions, affecting the risk taking behaviour of financial intermediaries. The link between low interest rates and financial intermediaries' risk-taking, points to the operation of a different channel of the monetary transmission mechanism, the so-called risk-taking channel. There are at least two ways in which this channel may operate. First, low returns on investments on safe assets may increase incentives for banks and institutional investors (such as pension funds) to take on more risk due to contractual or institutional commitments (for example, to meet a target nominal return) (Brunnermeier, 2001 and Rajan, 2005). Second, low interest rates affect asset price valuations and volatility, which in turn can determine adjustments in banks' balance sheets. In particular, as banks tend to target leverage ratios, an increase in stock prices and in the value of banks' equity encourages the expansion of their balance sheets. In this context, the transmission mechanism of monetary policy should take the liquidity and leverage of market based financial intermediaries explicitly into account. Financial intermediaries have an impact on financial conditions, affecting real economic outcomes, in particular GDP components that are most sensitive to credit supply (housing investment, durable goods consumption).

Borio and Zhu (2008) and Adrian and Shin (2008) find empirical evidence that balance sheet variables of financial institutions have important effects on macroeconomic dynamics. In addition, they find that expectations of an increase in the Federal funds rate target and also contemporaneous changes are associated with declines in investment banks assets. Gambacorta (2009), using a comprehensive data-base of listed banks from the European Union and the United States, finds evidence that when interest rates are low for an extended period of time banks' risk-taking tend to rise. In addition, using micro data for Spanish banks Jiménez *et al.* (2010) find out that monetary policy has an impact on the level of risk of individual Spanish banks in two conflicting ways. In the short term, low interest rates reduce the probability of default of outstanding variable rate loans, by reducing the interest burden of existing borrowers. In the medium term, however, due to the higher collateral values and the search for yield, banks tend to grant loans to riskier borrowers and, in general, to soften their lending standards: they lend more to borrowers with bad credit histories and with more uncertain prospects. Overall, these results suggest that low interest rates reduce credit risk in banks' portfolios in the short term – since the volume of outstanding loans is larger than the volume of new loans – but raise it in the medium term. These results are consistent with the existence of a risk-taking channel.

II.3. Monetary policy implementation under financial instability

The monetary policy transmission mechanism begins when the central bank sets official interest rates. The central bank's ability to influence interest rates lies in its monopoly power to issue base money, as it can control the funding costs of primary liquidity and, consequently, steer short-term market interest rates.[8] Under "normal" conditions, the central bank cannot steer both prices and quantities.[9] Most

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8 We ignore cases where the central bank operates under a structural liquidity surplus, given the most common situation is of a structural liquidity deficit where the central bank controls interest rates by providing liquidity to the financial system. The liquidity deficit is mostly determined by the demand for banknotes and reserves.

9 Goodhart (2010) mentions that liquidity management can have a degree of freedom from interest rate policy even when this is above the zero lower bound. He considers that the system of interest rates corridor allows for this independency between the setting of interest rates and liquidity management.

central banks aim at steering an operational target, usually a short-term interest rate, while promoting free and open market practices. Given the objective and strategy of monetary policy, the central bank monetary policy implementation is given by three elements: the definition of an operational target, the setting of the operational framework and the daily use of the instruments to attain the target (Bindseil, 2004). The definition of the operational framework should take into account the impact on the financial system and its main features.

The operational framework of monetary policy comprises three blocks: (i) the central bank balance sheet management, (ii) the counterparty framework and (iii) the collateral framework. The central bank balance sheet management involves managing the size and composition of the balance sheet. Regarding the size of the balance sheet, the central bank determines the overall liquidity deficit with which it operates and the reserve requirements, namely their mandatory or voluntary nature, the reserve ratio and the remuneration. The composition of the central bank balance sheet focuses mostly on the asset side and is related to the choice of instruments.[10] The counterparty framework defines the set of institutions with which the central bank interacts. Finally, the collateral framework defines the rules for financial assets being eligible as a guarantee to central bank operations, as well as the risk management measures.

One of the fundamental functions of central banks at their origin is the lender of last resort (LLR) function, which comes from the monopoly and virtual unlimited ability to print money. According to the "classical" theory of the LLR (Bagehot, 1873), the central bank should be available to provide funds, with known rules ex-ante, to illiquid but solvent banks, at a penalty rate with adequate collateral. The objective of the LLR role is to guarantee financial and macroeconomic stability. The credibility and widespread acceptance of central bank money means that agents perceive that the central bank can provide liquidity to distressed institutions in order to preserve systemic stability. This role is not attainable solely by banking and financial regulation and supervision. Therefore, there is a clear and necessary interaction between monetary policy (more specifically, the liquidity management function) and financial stability purposes (Gaspar, 2006). This interaction is at the origins of central banking and is essential to it.

The current literature considers that there is a LLR role available for central banks when there is asymmetric information, namely when it is difficult to correctly evaluate financial institutions' balance sheets, to distinguish between solvency and liquidity, and when interbank market spreads are elevated (Freixas *et al.*, 2004). This makes the LLR acting more likely to occur under stress situations.

To illustrate the broad role of the LLR, we compare the situation in a well functioning financial system to that of a crisis period. Under normal conditions, the central bank provides liquidity such that it meets aggregate demand for liquidity by the banking system, in order to steer money market interest rates in line with policy rates. In these cases, funding markets are assumed to function properly without frictions, such that individual liquidity imbalances net out in the aggregate, *i.e.*, banks and other financial intermediaries trade among each other and the market clears, as shown in chart 2.

In crisis situations, counterparty risk makes individual banks' liquidity positions matter (Heider *et al.*, 2009). Overall, banks prefer to hold more liquidity due to precautionary reasons, and so increase the price for liquidity, *i.e.*, market interest rates. At the same time, banks perceived to be riskier may be excluded from market funding and transactions (*e.g.* Bank C in chart 3). In this case, the central bank has to provide more liquidity to the banking system in order to keep steering interest rates towards the target. Note, however, that this higher liquidity provision may not be enough to guarantee an adequate distribution of liquidity within the banking system. For the banking system as a whole there might be excess liquidity, but this may be concentrated in a group of banks, who prefer to deposit the funds in excess back at the central bank (at a penalty rate) than to lend to other financial institutions given the high counterparty risk (*e.g.*: Bank A in chart 3). If a solvent and systemically relevant financial institution

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10 We assume a closed-economy perspective where foreign currency reserves and operations are not relevant.

Chart 2

LIQUIDITY FLOWS UNDER 'NORMAL' MARKET CONDITIONS

```
                          ┌─────────────────┐
                          │  Central Bank   │
                          └─────────────────┘
                 ╱                 │                 ╲
                ↓                  ↓                  ↓
      ╭──────────────╮   ╭──────────────╮   ╭──────────────╮
      │    Bank A    │←→ │    Bank B    │←→ │    Bank C    │
      ╰──────────────╯   ╰──────────────╯   ╰──────────────╯
          ↕          ╲         ↕         ╱          ↕
          │           ╲        │        ╱           │
          │        ┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐            │
          │          Financial markets              │
          │        └ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘            │
          ↕           ↕                 ↕            ↕
   ╭──────────────╮                        ╭──────────────╮
   │Other financial│                       │Other financial│
   │  institution  │                       │  institution  │
   ╰──────────────╯                        ╰──────────────╯
```
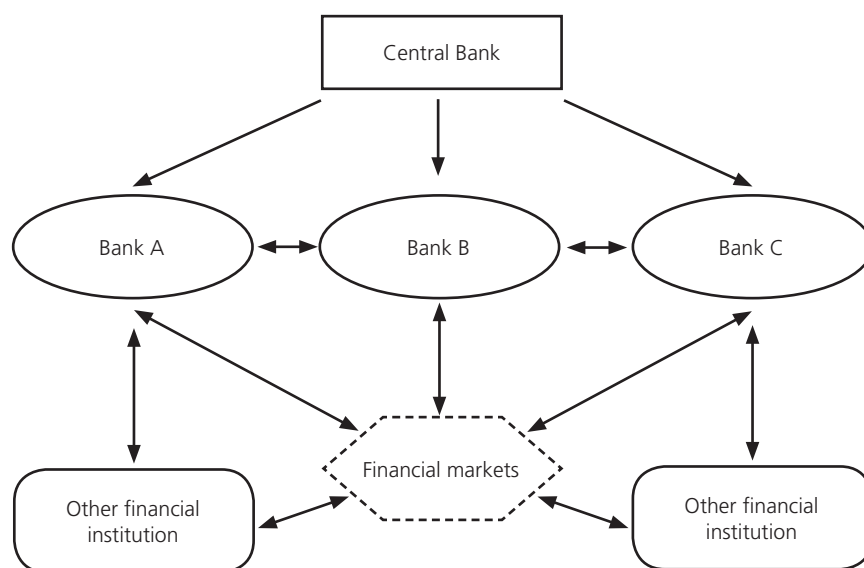
is excluded from funding markets because its credit risk is perceived to be elevated, the central bank should intervene as LLR and avoid contagion risk to other financial institutions. Note that this may imply the provision of liquidity to financial institutions that are not regular counterparts in monetary policy operations. This example shows that during the crisis, the objectives of financial stability and monetary policy become very much intertwined, as a collapse of the banking system would inevitably carry with it serious downside risks to price stability in a context of a seriously hampered interest rate policy.

When the disruptions in financial intermediation are very severe, as in a major financial crisis, interest rate policy may not be enough to counter downside risks to price stability. Once the zero lower bound (ZLB) is reached, liquidity management may cease to be solely geared to implementing the interest rate target but may also be used with monetary policy purposes (Goodhart, 2010). In these cases, monetary policy actions contribute both to price stability and financial stability objectives and therefore becomes more difficult to distinguish from macro-prudential policy.

One important instrument available to the central banks in these circumstances is credit policy which aims at stimulating credit to the economy by providing funds at longer maturities, for instance, by buying public or private debt securities thereby restoring the normal transmision mechanism of monetary policy. The concept of credit policy should not be confused with quantitative easing (*i.e.* the expansion of central bank money). In fact, credit policy can be implemented with or without resorting to monetary issuance. In addition, quantitative easing may be implemented to counteract downside risks to price stability but with no specific goal of restoring financial stability or the normal flow of credit to the economy.

Credit policy should help reduce market interest rates, contributing to the stability of financial institutions and to improve the functioning of some financial market segments. Central banks can provide credit via the banking system, via other financial intermediaries or directly to the non-financial sector.

In the short-run, increased central bank intermediation is very important for stabilizing the financial system. However, in the medium to long-run, it carries greater operational and rollover risks for the counterparties, possible efficiency and social costs related to moral hazard issues and the crowding-out of money market activity, besides greater credit risks to the central bank. De Walque *et al.* (2010)

Chart 3

LIQUIDITY FLOWS UNDER STRESSED MARKET CONDITIONS (SIMILAR TO THE FINANCIAL CRISIS WHICH STARTED IN 2007)
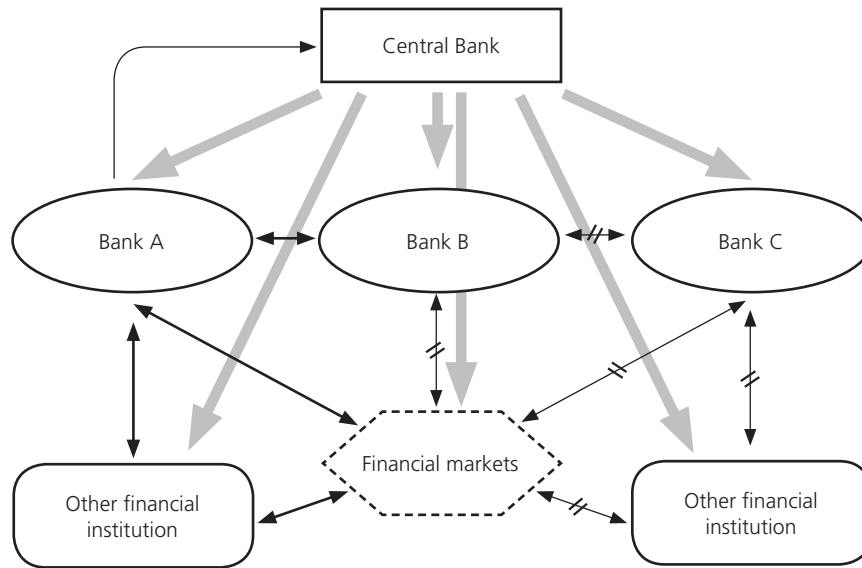
mention that, in the long run, increased central bank intermediation in response to financial crisis can lead to a higher persistence of the original negative shock.

Credit policy has also potential adverse effects on financial stability, since it might reduce liquidity in the segments for which the central bank buys the assets, or even create adverse incentives for banks to invest in those assets given that they rely on central bank purchases. However, these effects can be greatly mitigated through an appropriate design of credit policy. Given that the banking sector is able to better monitor debtors than the policy authorities, credit policy can also have large potential social costs related with moral hazard behaviour by debtors and the maintenance of inefficient ("zombie") banks and firms.

Recent research has not yet provided conclusive results on the effectiveness of credit policy. Some authors argue that credit policy should only be activated following an increase in credit spreads which reflects severe financial disturbances (Cúrdia and Woodford, 2009 and 2010). Gertler and Kiyotaki (2010) results favour more strongly the use of credit policy in response to financial shocks, with credit policy being able to almost eliminate the effects from financial frictions. Overall, there seems to be a consensus that both enhanced liquidity provision and credit policy should be seen as temporary measures to be used only in crisis periods.

III. The future role of macro-prudential policy and its interaction with monetary policy

From the discussion above, it can be concluded that monetary and financial stability can be complementary. However, there are also situations in which conflicts between the two policies can arise (Gaspar, 2010). An example is the case when there are financial frictions whose effects can be reduced by forfeiting the price stability goal. For instance, Di Fiore *et al*. (2010) find that the optimal policy would deviate from the traditional outcomes of a simple Taylor rule when there are financial frictions (internal and external funds are imperfect substitutes, firms' assets and liabilities are denominated in

nominal terms and debt-contracts are not state-contingent). In particular, if there is a negative shock to internal funds, it is optimal to engineer a controlled period of inflation to allow firms to deleverage and to avoid bankruptcies.

It should be noted that the above prescriptions arise in settings when no other instrument is used to address financial instability such as macro-prudential policy. Macro-prudential policy is here understood as the administrative and regulatory powers and the set of instruments aiming at ensuring financial stability in two dimensions: (i) a robust financial system able to absorb shocks without major disturbances to the real economy and (ii) the contention of the accumulation of systemic financial risks and fragilities. Macro-prudential policy is thus closer to macroeconomic policy in terms of objectives but also closer to micro-prudential policy in terms of instruments (Bank of England, 2009).

Several macro-prudential instruments have been put forward; for example, prudential ratios, counter-cyclical capital buffers, loan-to-value ratios for mortgage lending, margin requirements and liquidity ratios. There is a strong relation between macro- and micro-prudential instruments, in the sense that the latter can be designed also for macro-prudential objectives. These instruments affect credit and asset prices and thus are likely to affect the monetary policy transmission mechanism, as shown in chart 4 (Cohen-Cole and Morse, 2010). In turn, monetary policy influences financial institutions decisions and asset prices and, consequently, financial stability and the macro-prudential policy assessment (De Graeve *et al*., 2008). Thus, monetary and macro-prudential policies will need to consider each others' impact, while it is also important to ensure the presence of mechanisms that facilitate the necessary interaction. An adequate combination of policies will necessarily depend on the specific situation. Angelini *et al*. (2010) find that monetary policy alone leads to a better result when the economy is hit by supply or demand shocks. When the economy is hit by a financial shock, macro-prudential policy is useful and coordination of policies improves total gains, coming from lower volatility in output and loans-to-output ratio, compensated by a larger volatility in inflation and interest rate (according to the authors, monetary policy "lends a hand" to macro-prudential policy).

Although a more active macro-prudential policy and the complementarity between monetary and prudential policies seem to be consensual, the institutional arrangements are still not yet clear. Some defend that the responsibility for macro-prudential stability should be assigned to the central bank (Caruana, 2010).[11] This would imply assigning to the central bank regulatory and supervisory powers that eventually will lead to the development of new structures within the central bank. Another possibility, that has been followed in Europe and in the US, is to assign the responsibility for macro-prudential stability issues to new institutions, in particular regarding the prevention and containment of systemic risk. In any case there are strong reasons for the involvement of central banks in these new institutions. In the European Union a new body – the European Systemic Risk Board (ESRB) – was created with the aim of increasing the focus on systemic risk within the framework of financial supervision. The ESRB has two main policy tools: it can issue risk warnings and it can provide recommendations for action for the European Union as a whole, to one or more Member States, to one or more European Supervisory Authority or to one or more national supervisory authority. This new body together with the other three European Supervisory Authorities (European Banking Authority, European Insurance Authority and European Securities Authority) constitute the European System of Financial Supervision. In the US the Financial Stability Oversight Council was created with the task of mitigating systemic risk and maintaining system-wide financial stability.[12] The main duties are: (i) identifying threats to the financial

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11 Goodhart (2010) argues in favour of a closer coordination between the Treasury and the authorities responsible for systemic stability, liquidity management and interest rate policy, which he considers that do not have to necessarily rely all with the central bank.

12 The Financial Stability Oversight Council is a new agency created together with the Office of Financial Research, and the Bureau of Consumer Financial Protection by the "Dodd–Frank Wall Street Reform and Consumer Protection Act" on 21 July 2010.

Chart 4

THE MONETARY TRANSMISSION MECHANISM WITH MACRO-PRUDENTIAL POLICY
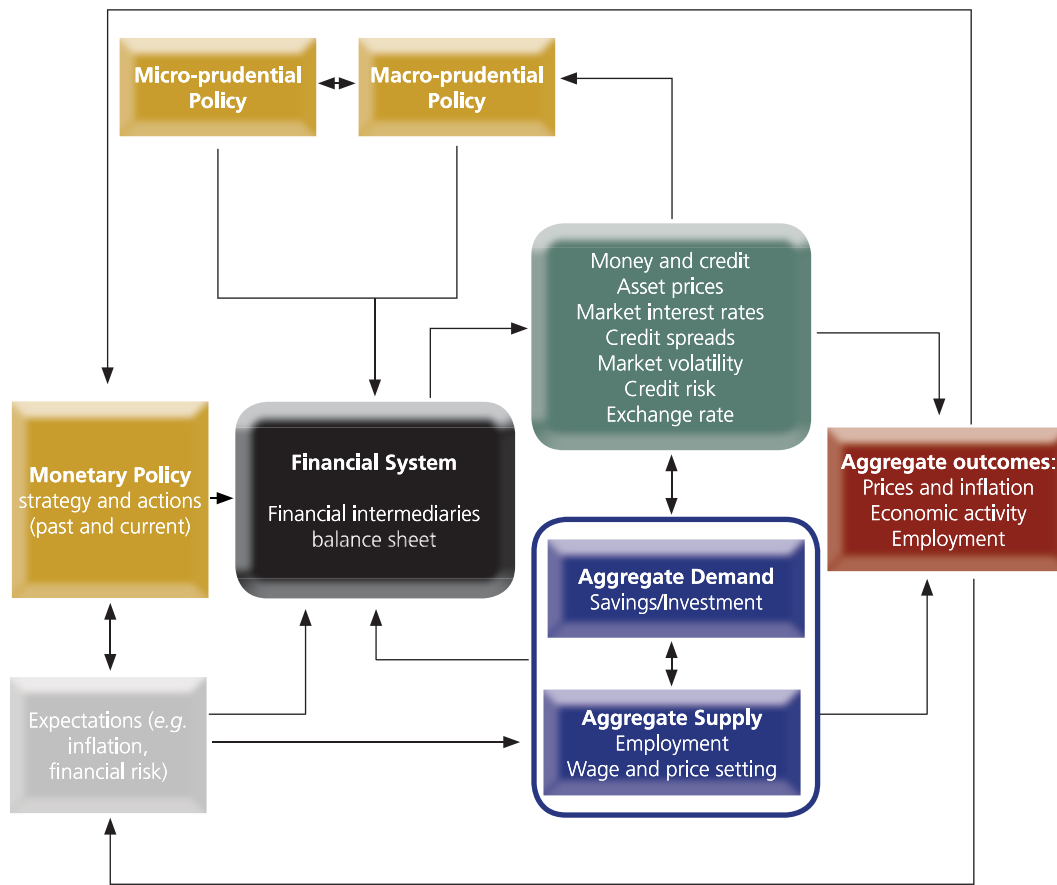
stability from both financial and non-financial organizations, (ii) promoting market discipline by eliminating expectations that the Government will shield them from losses in the event of failure, and (iii) responding to emerging risks to the stability of the financial system. The Council is an interagency body.

Whatever the institutional scheme implemented some principles of governance will have to be satisfied to preserve the central bank credibility and safeguard the correct functioning of monetary policy. In particular, it is important to define clear mandates for monetary policy and macro-prudential functions and effective communication policies regarding the decisions taken. There seems to be no reason to change the primary focus and responsibility for monetary policy on price stability, while macro-prudential policy should aim at strengthening the resilience of the financial system to adverse real and financial shocks and prevent the emergence of macroeconomic imbalances. In addition, given the central role played by the financial system in the monetary policy transmission mechanism, macro-prudential decisions must be taken into account by monetary policy and the exchange of information between the two relevant authorities should be promoted.

IV. Conclusions

The recent crisis showed that monetary policy must take into account financial stability issues. The crisis has not, however, overturned the idea that the primary focus and responsibility of monetary policy should be to maintain price stability. In this respect, one should not overlook the fact that, in spite of the

dimension of the recent crisis, monetary policy remained highly successful in maintaining price stability.

The adjustment of the monetary policy frameworks to take into account financial stability has recently received a lot of attention in economic policy debates. Several proposals that involve different degrees of changes to the conventional framework have been put forward. These proposals range from strengthening the understanding and monitoring of macro-financial interactions to more drastic ones that propose to add financial stability as a distinct policy objective and even the use of monetary policy for financial stability purposes. Several efforts are being done to build models with explicit and more detailed financial sectors. In particular, central banks have responded to the challenges posed by the ongoing financial crisis by putting high priority on modelling the financial sector, within both traditional and dynamic stochastic general equilibrium (DSGE) models. These modelling efforts have mostly focused on including particular financial variables and/or frictions, and, in some cases, on developing satellite models. In addition, some efforts are being done to develop complementary modelling approaches, by exploring alternative expectations formation mechanisms or by including heterogeneous agents within possibly nonlinear models. However, more fundamental research is needed regarding the development of macroeconomic models with complex financial sectors, before their use in forecasting and policy analysis is feasible.

The recent financial crisis has also illustrated the importance of financial stability for the monetary policy transmission mechanism. The recent literature emphasised the increased importance of some channels and has identified new channels of transmission. In addition, it has also been shown that there are other instruments that can be used for monetary policy in crisis times beyond interest rates, which also contribute to financial stability. These findings suggest that the existing models should be enhanced to capture in more detail these interactions with the financial system. Regarding the use of non-standard monetary policy measures, the consensual view is that, in normal times, there should be a complete separation of monetary policy from liquidity management. In crisis periods it is difficult to disentangle the two and monetary policy and financial stability objectives interact strongly.

The new consensus recognises that the build-up of excesses need to be addressed by a combination of policies and not by monetary policy alone. In particular, macro-prudential policies, regulatory policies (*e.g.* loan-to-value ratios, capital requirements, liquidity ratios) and even fiscal policy should be enhanced to address financial instability. However, it would be desirable to avoid excessive activism or fine tuning from such policies, in particular regarding credit growth and asset prices, as such measures could complicate the operation of monetary policy and reduce the social benefits from financial intermediation. Instead, the policies should aim at containing systemic risk on a structural basis and ensuring that the financial system is sufficiently robust to absorb large shocks.

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ECONOMIC POLICY AND SITUATION

II

OUTLOOK FOR THE PORTUGUESE ECONOMY: 2011-2012

OUTLOOK FOR THE PORTUGUESE ECONOMY: 2011-2012[1]

Following the established practice of Banco de Portugal, and in line with the rules of the Eurosystem projection exercises, the current projections only consider the fiscal consolidation measures that have been specified in sufficient detail and approved, namely those within the scope of the State Budget for 2011. Against this background, it is important to stress that the fiscal developments underlying the current exercise do not reflect all the measures required for compliance with the demanding fiscal targets assumed by the Portuguese State for 2011 and, in particular, for 2012. In 2011 the persisting non-negligible implementation risks are due, inter alia, to the unprecedented magnitude of fiscal conso-lidation. In 2012, the range of additional permanent measures required for meeting the target implied in the commitment of the authorities attains a rather significant level. Adopting such measures implies a substantial contraction of economic activity, similarly to the one projected for 2011.

In addition, the current outlook does not yet take on board the inevitable deleveraging process in the private sector, including the banking system. In the latter case, the nature of this process will be defined in more detail in forthcoming months. In any case, it will certainly imply significant changes in financing conditions and an increase in the respective degree of tightness, determining additional downside risks to economic activity.

Hence, results pointing to a 1.4 per cent contraction of economic activity in 2011, followed by a 0.3 per cent growth in 2012, are particularly conditional on the abovementioned assumptions. Given that some measures for 2012 have not yet been defined, results for that year should be put into special perspective, considering that neither the budget consolidation process, nor the economy deleveraging process will be concluded in 2011 and that their accomplishment is essential to promote the effective adjustment of external financing needs. In effect, these are virtually stable in the current outlook, in spite of the strong fall in domestic demand and the favourable performance of exports.

Table 1

PROJECTIONS OF BANCO DE PORTUGAL: 2011-2012 | ANNUAL RATE OF CHANGE, PER CENT							
	Weights 2010	EB Spring 2011			EB Winter 2010		
		2010	2011(p)	2012(p)	2010	2011(p)	2012(p)
Gross Domestic Product	100.0	1.4	-1.4	0.3	1.3	-1.3	0.6
Private Consumption	66.6	2.0	-1.9	-1.0	1.8	-2.7	-0.5
Public Consumption	21.3	3.2	-6.6	-1.0	3.2	-4.6	-1.0
Gross Fixed Capital Formation	19.5	-4.8	-5.6	-1.3	-5.0	-6.8	-0.4
Domestic Demand	107.6	0.8	-3.6	-1.0	0.5	-3.6	-0.5
Exports	28.0	8.7	6.0	6.5	9.0	5.9	6.1
Imports	35.6	5.3	-1.6	2.0	5.0	-1.9	2.4
Contribution to GDP growth (in p.p.)							
Net exports		0.5	2.5	1.4	0.7	2.5	1.1
Domestic demand		0.9	-3.9	-1.1	0.6	-3.9	-0.6
of which: change in inventories		-0.2	-0.1	0.0	-0.3	0.2	0.0
Current plus Capital Account (% of GDP)		-8.7	-8.9	-8.3	-8.8	-7.1	-7.0
Trade Balance (% of GDP)		-6.5	-5.5	-3.7	-6.4	-3.9	-2.9
Harmonised Index of Consumer Prices		1.4	3.6	2.0	1.4	2.7	1.4

Source: Banco de Portugal.

Notes: (p) projected. For each aggregate, this table shows the projection corresponding to be the most likely value, conditional on the set of assumptions considered.

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1 The outlook for the Portuguese economy is based on information available up to mid-March 2011.

Robust growth of external demand and tighter financing conditions

Current projections are based on a set of assumptions on future developments regarding the external environment and public finance variables of the Portuguese economy (Table 2).

In terms of the outlook for economic activity and international trade developments, underlying the current assumptions are the projections of the European Central Bank published in the March 2011 issue of its Monthly Bulletin. They imply marked growth of external demand both in 2011 and in 2012, in spite of a clear deceleration from 2010.

Turning to financing conditions, the current assumptions reflect the information available in financial markets in mid-March 2011, which points to a gradual increase in the short-term reference interest rate (three-month EURIBOR). As regards the interest rate on the Portuguese ten-year sovereign debt, the technical assumption considered, which comprises an unchanged interest rate differential vis-à-vis Germany within the projection horizon, implies a gradual increase over 2011 and 2012. In addition, lending standards applied to domestic banks in international wholesale debt markets will probably remain particularly tight, even though this outlook does not incorporate banking sector deleveraging.

The technical assumptions on exchange rates, which consider that these will remain unchanged at mid-March levels, imply an appreciation of the euro vis-à-vis the dollar in 2011, and a stabilisation in effective terms. In turn, according to information available in futures markets, the oil price is expected to increase in 2011 to approximately USD 110 per barrel, in annual average terms, stabilising at that level in 2012.

The current assumptions point to a slight upward revision of external demand and interest rates *vis-à--vis* those considered in the winter 2010 issue of the Economic Bulletin. In addition, these assumptions include a higher appreciation of the effective exchange rate in 2011 than previously considered, as well as the stabilisation of the oil price at a higher level.

The assumptions regarding public finance developments only considered, in line with Eurosystem projection rules, the fiscal policy measures legally approved, or with a high probability of legal approval, and specified with sufficient detail. Hence, the current outlook incorporates, in particular, the set of budget consolidation measures approved within the scope of the State Budget for 2011.

Table 2

PROJECTION ASSUMPTIONS		EB Spring 2011			EB Winter 2010		
		2010	2011	2012	2010	2011	2012
External demand	yoy	9.3	5.6	6.2	8.6	5.1	5.9
Interest rate							
Short term	%	0.8	1.5	2.3	0.8	1.3	1.9
Long term	%	5.4	7.6	7.9	5.3	6.2	6.6
Euro exchange rate							
Euro effective exchange rate	yoy	-6.3	-0.1	0.3	-6.3	-1.8	0.0
Euro-dollar	aav	1.33	1.38	1.39	1.32	1.32	1.32
Oil price							
in dollars	aav	79.6	111.1	110.3	79.6	89.9	90.4
in euros	aav	60.1	80.2	79.3	60.1	68.3	68.6

Sources: ECB, Bloomberg, Thomson Reuters and Banco de Portugal calculations.
Notes: yoy - year-on-year rate of change, % - per cent, aav - annual average value. An increase in the exchange rate represents an appreciation.

GDP growth of 1.4 per cent in 2010

The Portuguese economy grew by 1.4 per cent in 2010, reflecting the significant growth of exports, private consumption and public consumption, which has more than offset the sharp fall in investment. Private consumption was significantly buoyant at the end of the year, partly due to fiscal changes (see box "Developments in car sales in 2010"). These Gross Domestic Product (GDP) developments imply a slight upward revision of activity growth projections in comparison with winter issue of the *Economic Bulletin*.

Economic activity contraction in 2011

The current outlook points to a 1.4 per cent contraction of economic activity in 2011 that under the abovementioned conditions would be followed by a 0.3 per cent recovery in 2012 (Chart 1). These developments are expected to imply a strong contraction of domestic demand, in contrast to buoyant exports. The contraction of domestic demand in 2011 and 2012 is broadly based across all its components and reflects in particular the impact of fiscal consolidation measures included in the State Budget for 2011, as well as the impact on consumer spending and private investment of changes in financing conditions oriented towards more severe tightness. As already mentioned, the need for additional fiscal consolidation measures as well as the deleveraging process will likely determine a significant fall in the growth rate of activity vis-à-vis the current projections, particularly in 2012. In this context, it is unlikely that the Portuguese economy shares the cycle of economic activity recovery at the European level in forthcoming years, although it may reap some benefits thereof in terms of external demand.

Private consumption, after 2 per cent growth in 2010, is projected to contract by 1.9 per cent and 1.0 per cent in 2011 and 2012 respectively (Chart 2). Developments in this variable over the projection horizon will likely be strongly influenced by the impact of fiscal consolidation measures on household permanent income prospects. In addition, continued adverse conditions in the labour market are likely to imply moderate wage developments in the private sector. Private consumption developments in 2011 reflect a 3.4 per cent fall in household real disposable income, as well as tighter conditions for access to credit. For 2012, in the absence of additional fiscal consolidation or private sector deleveraging measures, real disposable income is projected to increase by 1.1 per cent, reflecting the fading-out of the effects of fiscal consolidation measures.
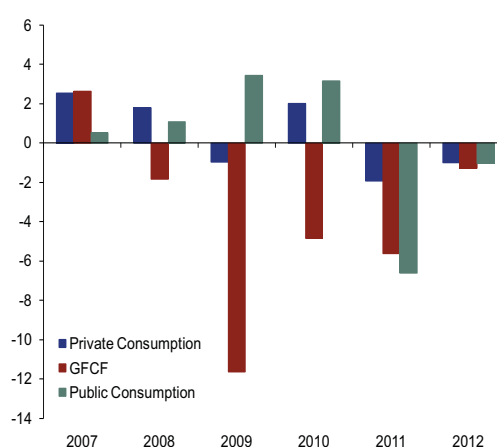
Chart 1

BREAKDOWN OF GDP GROWTH | CONTRIBUTION TO THE ANNUAL RATE OF CHANGE

Legend: Net exports; Domestic Demand; GDP (yoy per cent)
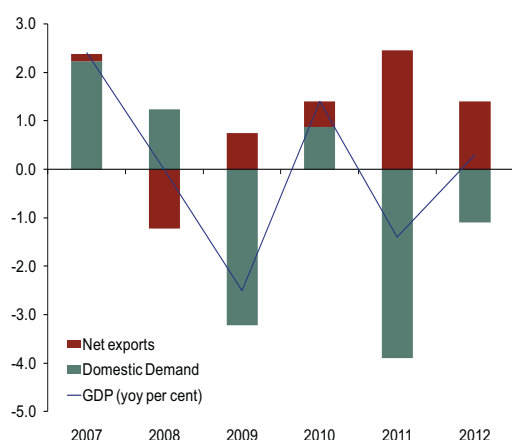
Sources: *INE* and Banco de Portugal.

Chart 2

DEVELOPMENTS IN DOMESTIC DEMAND | ANNUAL RATE OF CHANGE

Legend: Private Consumption; GFCF; Public Consumption

Sources: *INE* and Banco de Portugal.

Gross fixed capital formation (GFCF) is projected to contract by 5.6 per cent in 2011 and 1.3 per cent in 2012. This reflects the impact of domestic demand development prospects on corporate investment decisions, as well as the effects of high uncertainty. In addition, this fall will likely be more marked owing to the prevailing tight financing conditions, which will certainly be reflected in a change in credit standards applied by banks to the approval of new loans for investment purposes.

Exports show robust growth in the current outlook, both in 2011 and 2012 (6.0 and 6.5 per cent respectively). This behaviour essentially reflects expected developments in external demand for Portuguese goods and services, within the framework of a virtual stabilisation of the market share. A sustained recovery of competitiveness in the Portuguese economy requires the adoption of a wide range of structural reforms. However, a fiscal policy reform is also likely to contribute in the short term to a rise in the external competitiveness of the Portuguese economy (see box "The impact of a tax change aimed at increasing the external competitiveness of the Portuguese economy").

Turning to imports, the current outlook points to a contraction of 1.6 per cent in 2011 that under the conditions determined by the current projections, would be followed by 2.0 per cent positive growth in 2012. These developments chiefly reflect the behaviour of import content-weighted overall demand adjusted for the impact of large acquisitions of military equipment in 2010. In this context, import penetration adjusted for these specific effects is projected to decline slightly in 2011, followed by a mild increase in 2012.

External borrowing requirements of the economy, as measured by the combined current and capital account balance, are expected to broadly stabilize over the projection horizon (Chart 3). This reflects a marked decline in the goods and services account deficit, benefiting from an increase in external demand and a fall in domestic demand, albeit in a context of unfavourable developments in terms of trade. In effect, the current outlook points to growth of 4.1 per cent for the export deflator and 7.5 per cent for the import deflator in 2011, reflecting not only the marked increase in energy commodity prices, but also robust growth in non-energy commodity and manufactured goods prices. In turn, the income account deficit is likely to widen in 2011 and 2012, reflecting the continued deterioration of the international investment position and rising financing costs.

As regards the labour market, the week performance of the economic activity is expected to imply a decline in employment of 0.9 per cent in 2011 and 0.3 per cent in 2012, after the 1.5 per cent fall in 2010. This evolution will affect both the private and public sectors, but more markedly in the latter case, in line with the cut in public administration employment envisaged in the public finance assumptions underlying the current outlook.

Compared with the winter 2010 issue of the Economic Bulletin, GDP growth is revised downwards by 0.1 p.p. in 2011 and 0.3 p.p. in 2012. In 2011, the adverse effects of an upward revision of household consumption spending and GFCF, chiefly reflecting the incorporation of information relating to the fourth quarter of 2010, are combined with a downward revision of public consumption. In 2012, weaker prospects of activity growth are due to a downward revision of both private consumption and GFCF, which are partly offset by higher-than-expected export growth.
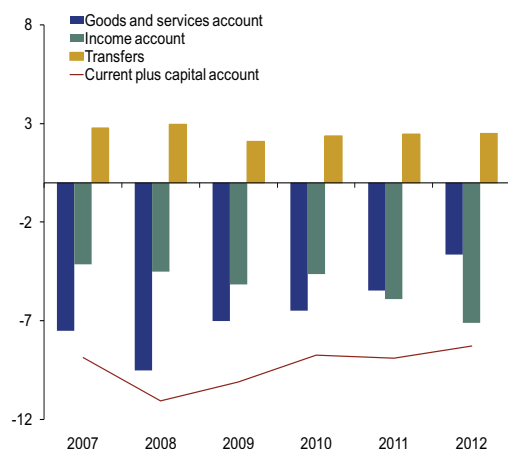
One-off rise in inflation in 2011 particularly due to fiscal consolidation measures and commodity price developments

The current outlook points to a one-off rise in HICP inflation to 3.6 per cent in 2011 (1.4 per cent in 2010), followed by a decline to 2 per cent in 2012 (Chart 4).

The rise in inflation projected for 2011 is mainly due to non-energy goods and services (from 0.3 per cent in 2010 to 2.4 per cent in 2011). These developments reflect, in particular, indirect tax increases in July 2010 and January 2011 and significant updates in prices of some goods and services subject to
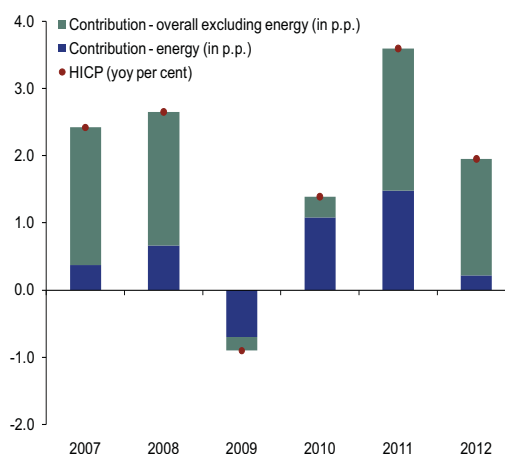
Chart 3

DEVELOPMENTS IN BORROWING
REQUIREMENTS | AS A PERCENTAGE OF GDP

- Goods and services account
- Income account
- Transfers
- Current plus capital account

Chart 4

INFLATION | CONTRIBUTION TO THE ANNUAL RATE OF
CHANGE OF THE HICP

- Contribution - overall excluding energy (in p.p.)
- Contribution - energy (in p.p.)
- HICP (yoy per cent)

Sources: *INE* and Banco de Portugal.

Sources: Eurostat and Banco de Portugal.

regulation. The joint contribution of these effects is estimated to reach around 2 percentage points. In turn, the energy price component is projected to increase by 12.3 per cent in 2011, chiefly reflecting oil price developments.

For 2012, the current outlook points to a HICP growth rate of 2 per cent, reflecting a deceleration in both the non-energy and energy components. The non-energy component is expected to increase by 2 per cent, mainly reflecting growth of both non-energy goods and services import prices and wage costs. In turn, the energy component is projected to decelerate by 2 per cent, in line with the prospects for oil prices.

Compared with the winter issue of the Economic Bulletin, the current outlook implies an upward revision of HICP growth by 0.9 p.p. in 2011 and 0.5 p.p. in 2012. The significant revision in 2011 results in particular of an upward revision of oil prices in euros and non-energy goods and services import prices, as well as a revaluation of price increases in a number of goods and services subject to regulation, within the scope of fiscal consolidation measures.

Downside risks for economic activity, particularly in 2012, and balanced risks for inflation

The current outlook, which is conditioned by an unusually high degree of uncertainty, incorporates downside risks for economic activity and balanced risks for inflation.

As regards economic activity, the necessary additional fiscal consolidation measures needed in order to meet the demanding fiscal commitments made by the Portuguese State determines downside risks for economic activity in 2011 and, more markedly, in 2012. This risk also interacts with the start of the deleveraging process of the private sector. The latter should imply a significant change in financing conditions and an increase in the respective degree of tightness, determining downside risks for private consumption and investment. The impact of this process on economic activity will depend on its configuration, especially its implications for new credit being granted by the banking system and the capability of non-financial corporations to restructure their financing policies, as regards both a more efficient use of financial resources, and the search for alternative financing sources, namely in the external market.

In turn, the buoyancy of global economic activity has implied higher-than-expected growth of external demand for Portuguese goods and services, as a result of the fading-out of a range of temporary factors

associated with the international financial crisis. The continuation of this process may lead to a higher-
-than-expected increase in world demand and exports and, therefore, to higher economic activity growth.
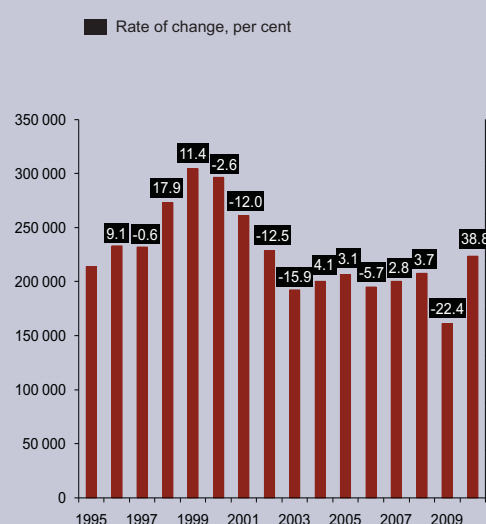
In terms of inflation, the growing political and economic instability in oil-producing countries is an upside
risk, given that it may lead to higher oil price increases. In turn, the compression in corporations' profit
margins may exceed projections, in a context in which the fiscal consolidation process and deleveraging
needs are likely to imply substantially lower economic activity growth than assumed in the current outlook.

BOX 1 | DEVELOPMENTS IN CAR SALES IN 2010

Car sales grew considerably in 2010 (38.8 per cent), thus making a significant contribution to the acceleration in private consumption *vis-à-vis* 2009 (Chart 1). These developments seem to have been influenced by the anticipation of purchases in a context of announcements of tax increases, materialised in a rise in the standard VAT rate as of July (1 p.p.) and January 2011 (2 p.p.), and in a reduction of the car scrappage incentive from January 2011 onwards (Chart 2).[1] In particular, the effects of the latter change are enhanced by the importance of sales within the scope of this car scrappage programme, in the context of an increase in the average age of the vehicle fleet. The purpose of this box is to assess the importance of these tax changes in car sales in 2010, whose reversal is likely to condition the behaviour of this variable in 2011.
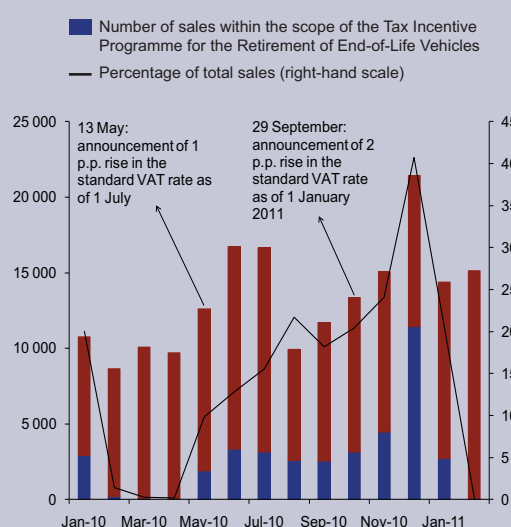
Chart 1

ANNUAL CAR SALES | NUMBER OF LIGHT PASSENGER VEHICLES

■ Rate of change, per cent

Source: *ACAP.*

Chart 2

CAR SALES IN 2010 | NUMBER OF LIGHT PASSENGER VEHICLES

■ Number of sales within the scope of the Tax Incentive Programme for the Retirement of End-of-Life Vehicles
— Percentage of total sales (right-hand scale)

Source: *ACAP.*

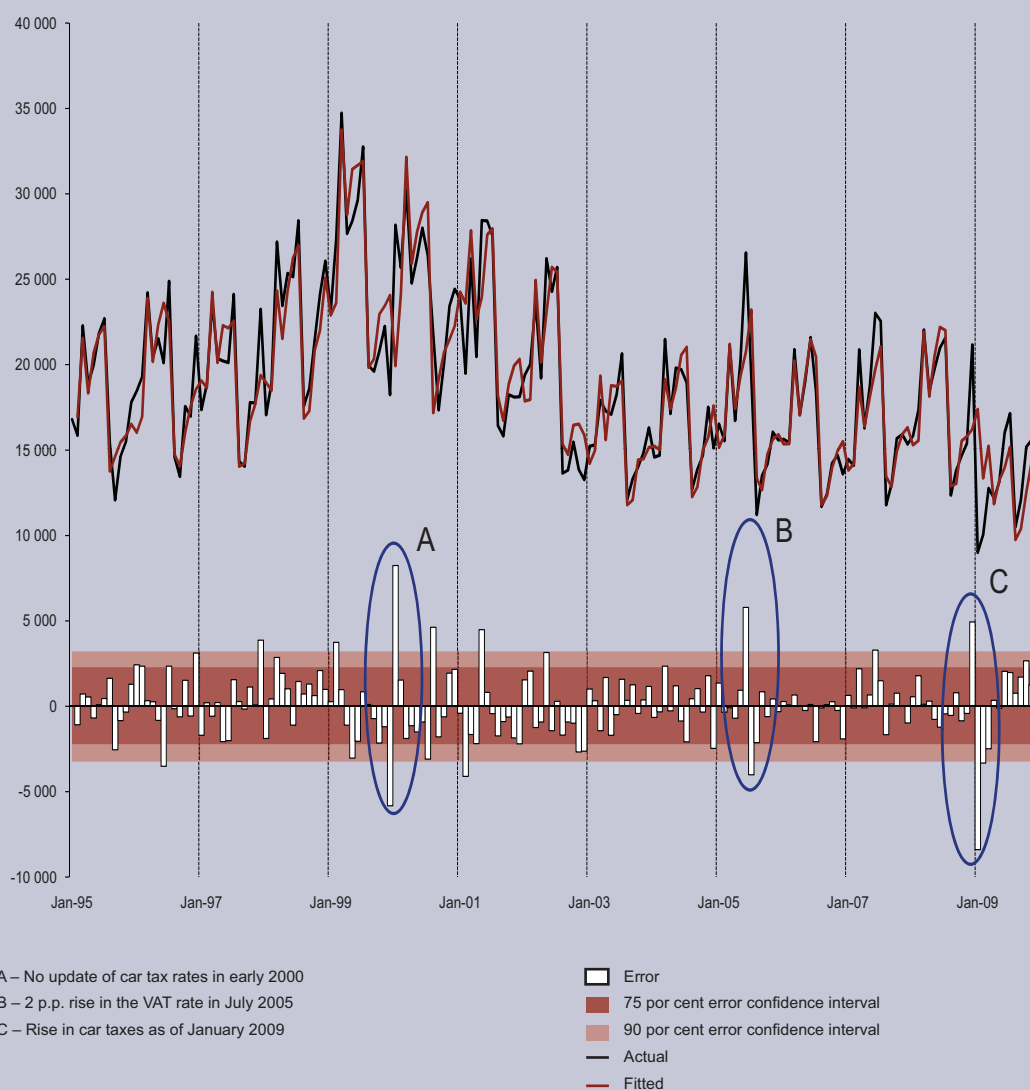### *Estimation of a model for car sales*

To quantify the impact of the changes referred to, as an initial step an econometric model was specified for the series referring to sales of light passenger vehicles. In particular, a univariate SARIMA (Seasonal Autoregressive Integrated Moving Average) model was considered. The model is identified through the usual Box-Jenkins methodology, and the respective estimation resorts to the non-linear least square method. This type of models in which a variable is only accounted for by its past statistical regularities is traditionally used within the scope of short-term projections.

Chart 3 shows the result of the fitted model for the 1995-2009 period, jointly with the series observed for sales of light passenger vehicles. The assessment of this model in the estimation period makes it possible to detect several episodes of statistically significant errors. In some cases, these episodes coincide with periods of important tax changes (Chart 3).

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1 From January 2011 onwards the incentive is only applicable to the purchase of electric cars.

Chart 3

BEHAVIOUR OF THE FITTED MODEL | NUMBER OF VEHICLES: JANUARY 1995 – DECEMBER 2009

A – No update of car tax rates in early 2000
B – 2 p.p. rise in the VAT rate in July 2005
C – Rise in car taxes as of January 2009

Error
75 por cent error confidence interval
90 por cent error confidence interval
Actual
Fitted

Source: Banco de Portugal.

In December 1999 there was a decline in car sales, offset by a remarkable rise in the following month. This seems to have been related to the fact that car tax rates were not updated at the beginning of the year due to the late entry into force of the State Budget for 2000. This may have led agents to defer the purchase of cars in late 1999, so that these could already have a license plate of 2000.
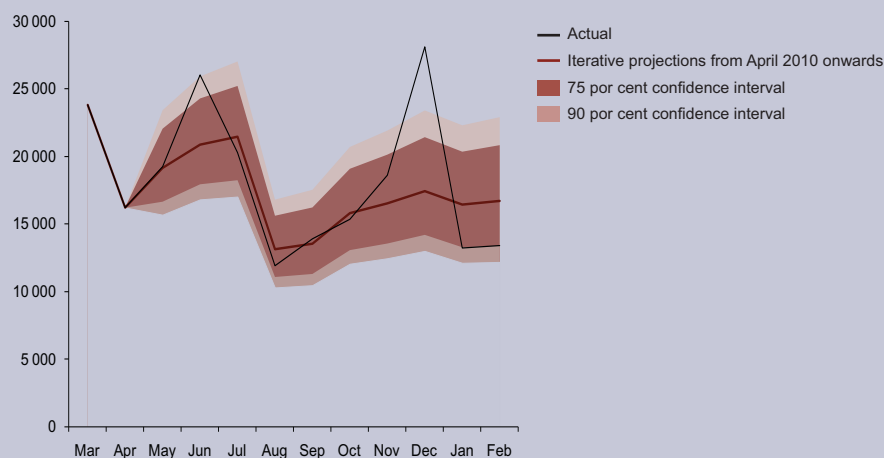
Throughout the period under review there are other clear episodes of anticipated car purchases associated with tax changes. In particular, there was a 2 p.p. rise in the VAT rate in July 2005 and changes in car taxes introduced in January 2009, namely a rise in the car tax rates and the elimination of the €500 tax deduction in the purchase of diesel-powered vehicles with lower particulate emissions.

An estimate of the impact of tax changes in 2010

This model enables an estimate of the impact of the above-mentioned tax changes. The intention was to gauge – through an iterative projection from April 2010 onwards – what would have been the underlying trend of vehicle sales over the year (Chart 4). The difference between the projected and the

Chart 4

| PROJECTIONS OF CAR SALES | NUMBER OF VEHICLES: MARCH 2010 – FEBRUARY 2011 |

Legend:
— Actual
— Iterative projections from April 2010 onwards
■ 75 por cent confidence interval
■ 90 por cent confidence interval

Source: Banco de Portugal.

observed figures will reflect all the effects that were not captured by the model, particularly the impact of tax changes and the usual irregularity associated with statistical series, wherefore the results of this type of exercise should be interpreted with caution.
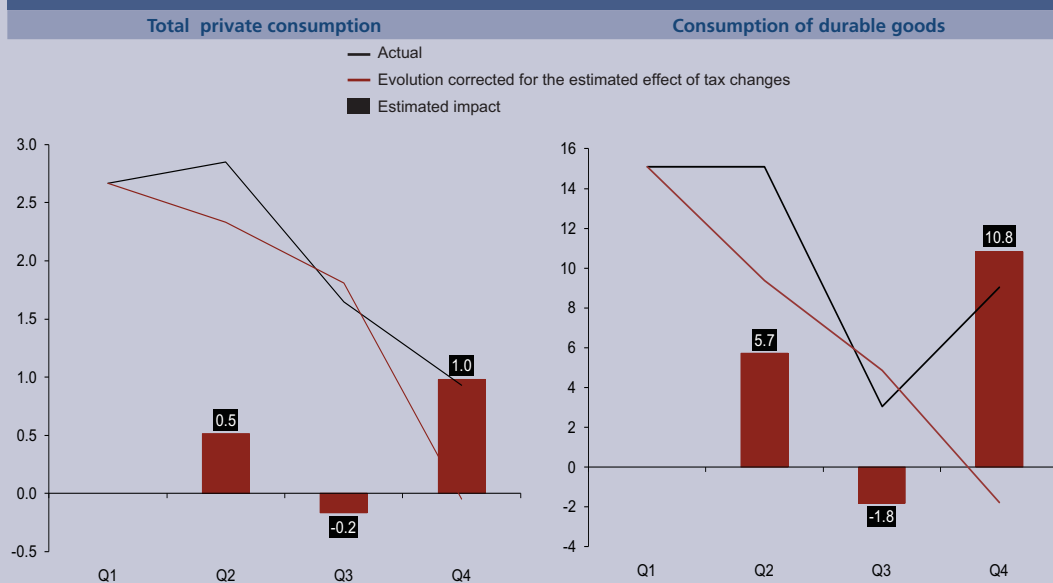
Following the announcement on 13 May of a rise in the standard VAT rate from 20 to 21 per cent as of July, sales in June were higher than projected, with a projection error statistically different from zero for a level of 90 per cent. This was also the case in December, following the announcement at end-September of a further rise in the VAT rate, to 23 per cent, and a reduction in the car scrappage incentive as of early 2011. In fact, car sales within the scope of the Tax Incentive Programme for the Retirement of End-of-Life Vehicles reached a historical peak in December 2010, corresponding to around 40 per cent of total sales.

Similarly to a few previous episodes, the anticipation of purchases tends to give rise to a downward correction in the months following a rise in taxation. This effect was also observed in January and February 2011 and will tend to negatively influence the sales volume in the year as a whole.

Based on this exercise, deviations observed throughout 2010 correspond to around 9.6 per cent of total car sales. The mechanical transposition of these effects into private consumption accounts for a 0.4 p.p. contribution to growth in total private consumption.

This mechanical exercise also makes it possible to have an order of magnitude of the impact of these measures on intra-annual developments in private consumption in 2010 (Chart 5). Without these effects private consumption would have decelerated more considerably over the year, with the year-on-year rate of change declining from 2.7 per cent in the first quarter to close to zero in the last quarter.

Chart 5

IMPACT OF CHANGES IN CAR TAXES ON PRIVATE CONSUMPTION | QUARTERLY FIGURES FOR 2010, YEAR-ON-YEAR
RATES OF CHANGE

Total private consumption	Consumption of durable goods

— Actual
— Evolution corrected for the estimated effect of tax changes
■ Estimated impact

Source: Banco de Portugal.

BOX 2 | THE IMPACT OF A TAX CHANGE AIMED AT INCREASING THE EXTERNAL COMPETITIVENESS OF THE PORTUGUESE ECONOMY

This box reviews a tax policy reform aimed at increasing the external competitiveness of the Portuguese economy. This reform consists in a reduction in employers' social security contributions offset by an increase in consumption taxes, with a nil impact on the budget balance and on the stock of public debt. Such tax structure change has a short-run impact similar to that of a real currency depreciation, making it all the more relevant in the case of a small country integrated in a monetary union.

Employers' social security contributions and consumption taxes affect labour/leisure decisions of economic agents through different channels. Cuts in employers' social security contributions result in lower wage costs and, consequently, in lower production costs. In a competitive environment, firms pass on decreases in the marginal production cost to the final price, thus increasing the competitiveness of domestic production. In turn, rises in consumption taxes only impact directly on the final price of consumer goods, but not on the price of exported goods; as such, tax changes bring about a real exchange rate depreciation, impacting on external competitiveness.

The tax reform analysis is performed using a general equilibrium macroeconomic model, the *PESSOA* model,[1] which makes it possible to analyse in an integrated manner the impact of these changes on the main macroeconomic variables and, ultimately, on welfare. Although this type of model is quite detailed, containing various transmission mechanisms, it is worth emphasising that the interpretation of results must take into account that general equilibrium models, as all economic models, are a stylised representation of reality and are based on simplifying assumptions that significantly condition the results obtained.

All simulations are performed in a context of perfect foresight, implying that the nature of the tax changes is known with certainty by all economic agents from the outset. However, in practice, economic agents tend to adapt gradually, rather than immediately, to such a change; consequently, simulation results tend to reveal a more immediate impact than the real impact.

This box presents the simulation results that illustrate the impact of a rise in VAT– equal to an increase in tax revenue equivalent to 1% of GDP ex ante (around +2 p.p. in the average VAT rate) –, which makes it possible to reduce employers' social security contributions by around 4 p.p., against an assumed background of nil impact on the budget balance and government debt.

Chart 1 illustrates impulse response functions for the main macroeconomic variables. Employers' social security contributions and consumption taxes affect economic agents' decisions in a different way, particularly as regards consumption and leisure decisions. Taxes on labour income (paid by households or firms) are particularly distortionary, given that they affect household intratemporal decisions. In turn, consumption taxes mainly affect intertemporal consumption decisions, i.e. the choice between current and future consumption, which, against a background where households have access to asset markets, are relatively less distortionary. In this context, replacing intratemporal decisions with intertemporal decisions has a significant positive impact on output and employment and, ultimately, on household welfare.

A reduction in employers' social security contributions results in lower production costs for tradable and non-tradable intermediate goods. The higher the degree of competition in these markets, the faster the pass-through of the reduction in marginal costs to their final price. It should be noted that this decrease in wage costs is not achieved at the expense of lower nominal wages. Moreover, the impact of this

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[1] For a detailed description of all *PESSOA* model features, see Almeida, V., Castro, G. and Félix, R. (2010), "Improving competition in the non-tradable goods and labour markets: the Portuguese case", *Portuguese Economic Journal*, Vol. 9, Issue 3.

Chart1

THE MACROECONOMIC IMPACT OF A TAX CHANGE AIMED AT INCREASING THE EXTERNAL COMPETITIVENESS OF THE PORTUGUESE ECONOMY | PERCENTAGE DEVIATIONS FROM THE BASELINE SCENARIO; INFLATION AND INTERNATIONAL INVESTMENT POSITION IN PERCENTAGE POINTS
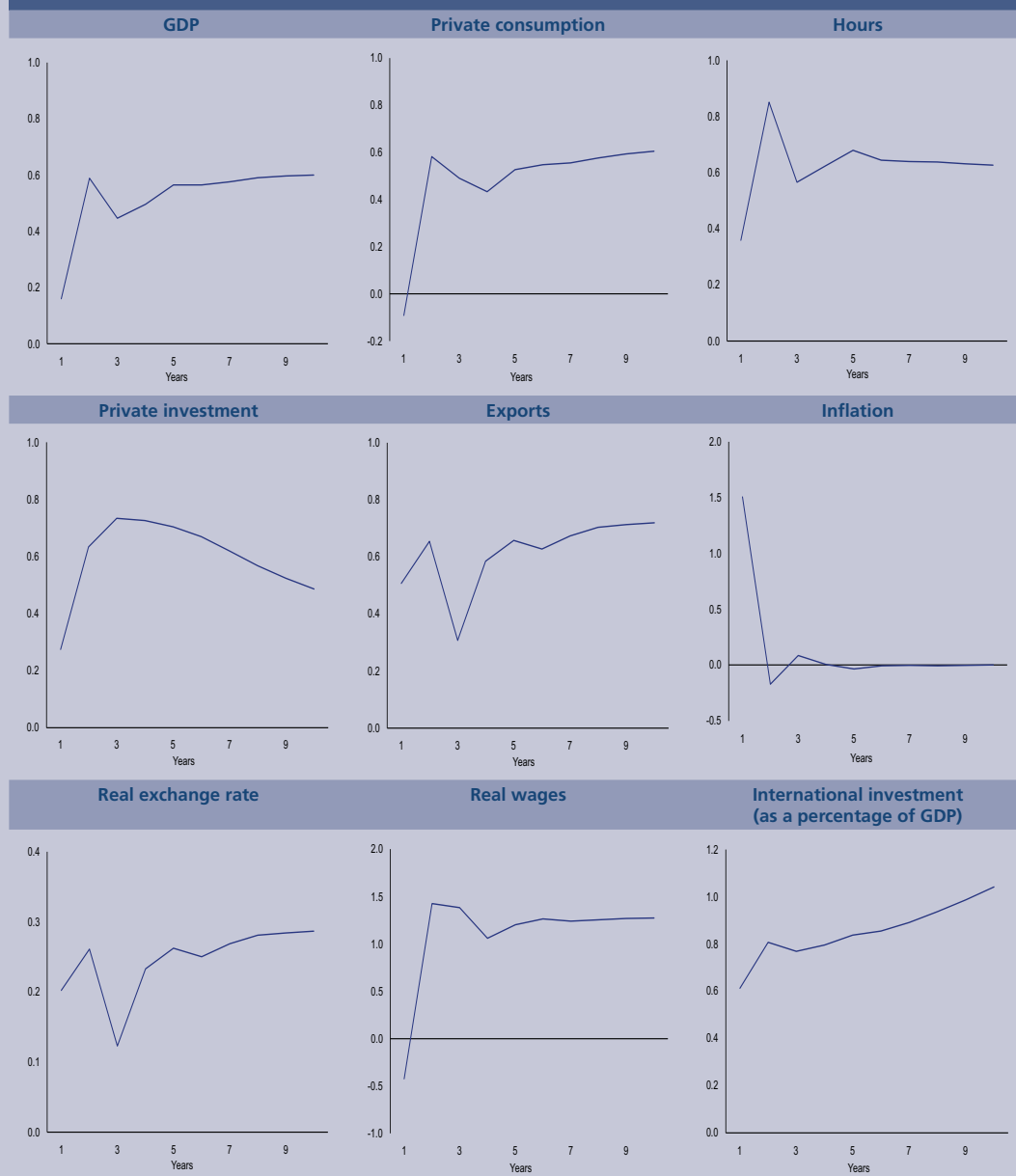
Source: Banco de Portugal.

Note: An increase in real exchange rate corresponds to a depreciation, thereby increasing international competitiveness.

measure is maximised if there is full pass-through to the final goods price. This pass-through may be more limited in the case of non-tradable goods, particularly if this measure is not complemented with reforms aimed at promoting greater competition in this market. Given that intermediate goods are used to produce final goods, production costs of final goods will also tend to decrease. The fall in the production cost of domestic goods *vis-à-vis* external market prices leads to a depreciation of the real exchange rate, which enhances international competitiveness of domestic production and thereby fosters a rise in exports and a decrease in the import contents. Therefore, such changes to the tax structure bring about a fall in the goods and services account deficit and a permanent improvement in the international investment position of the Portuguese economy.

Lower wage costs and higher demand for domestic goods foster labour demand, thereby driving real wages upwards; this, on the one hand, limits international competitiveness gains and, on the other, compensates households for the decline in their purchasing power associated to consumption tax rises. In the new steady state, economic activity as well as hours worked increase, resulting in higher export, private consumption and investment levels.[2] Notwithstanding the positive impact in the medium and long run, private consumption drops in the short run. This effect arises from the increase in the VAT rate that implies, *ceteris paribus*, a decrease in real wages and, therefore, in households' real disposable income.

Finally, changes to the tax structure must be assessed relative to their impact on household welfare. The welfare analysis, using the utility function included in the *PESSOA* model, implies the choice of a discount rate that mirrors the average planning horizon of economic agents and necessarily reflects the relative weighting of the short, medium and long-run impact of the tax measures introduced. Three alternative planning horizons are considered: 5, 16 and 40 years. Results illustrated in Table 1 point to welfare gains, irrespective of the planning horizon. Changes to the tax structure aimed at increasing the external competitiveness of the Portuguese economy are likely to induce welfare gains equal to a permanent increase in per capita consumption between 0.6 and 1.3 per cent for economic agents with a 5 to 40-year planning horizon.

The welfare analysis should be interpreted with caution, given that the *PESSOA* model, like most dynamic general equilibrium models, does not take into account the heterogeneity underlying the household income distribution, which may have significant implications for the assessment of these policy measures. Higher taxes on private consumption are likely to affect, in particular, lower-income households, and may induce considerable changes in consumption distribution. In this type of model, the household welfare analysis does not capture the assessment of the impact of inequality changes on aggregate household welfare, thus limiting any policy considerations that may be withdrawn from this analysis.

The implementation of such a tax change faces a number of operational obstacles that are worth highlighting. Taxes on consumption in Portugal have increased significantly over the past few years. The standard VAT rate stands at 23 per cent, being one of the highest in the euro area. Therefore, any additional increase may encourage VAT evasion. In this context, an increase in consumption taxes would mean raising the reduced and intermediate rates, resulting in more harmonised VAT rates.[3] This tax change would lead to higher taxes on staple goods, with non-negligible effects on household real income and consumption levels, particularly in the case of lower-income households. One way to ensure a fair impact of this reform would be to compensate those households that are relatively more affected by an increase in the VAT rate via a monetary transfer. As an illustration, the reform could combine a transfer to households of 10 per cent of the ex-ante revenue stemming from the increase in the average VAT rate, which would imply a slightly smaller decrease in employers' social security contributions, so as to ensure a final nil impact on the budget balance and government debt.

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2 For the purpose of assessing the sensitivity of these results to the parameter representing the elasticity of labour supply to real wages, the same scenario was simulated using different calibrations for this parameter. Medium and long-term findings are equivalent in qualitative terms, although the magnitude of impacts is amplified when the elasticity of labour supply to real wages is higher. Differences arise from the fact that in an economy where labour supply is more elastic to real wage developments, taxes on labour income are more distortionary. In this context, cuts in employers' social security contributions induce higher competitiveness gains and, therefore, amplify the impact on the economy of changes in the tax structure.

3 In this regard, it should be noted that economic literature clearly suggests that taxes on the consumption of most goods and services should have a uniform rate (with the notable exception of goods with negative externalities), so as to minimise distortions in economic agents' decisions. See, in particular, J. Mirrlees, S. Adam, T. Besley, R. Blundell, S. Bond, R. Chote, M. Gammie, P. Johnson, G. Myles and J. Poterba (eds), *Dimensions of Tax Design: the Mirrlees Review*, Oxford University Press, 2010.

To sum up, a change in the tax structure reducing employers' social security contributions via an increase in consumption taxes – which can also be complemented with monetary transfers to households –, with a nil final impact on the budget balance and government debt, is likely to increase the competitiveness of the Portuguese economy, as well as output, consumption and employment levels. The magnitude of these effects may be rather substantial. It is particularly noteworthy that a scenario of fully harmonised VAT rates would have a macroeconomic impact around four times higher than that described in this box. Therefore, more thought is needed on the implications of a tax reform bearing such features, which could be particularly relevant in the current framework of protracted adjustment of the Portuguese economy. However, these measures do not replace nor mitigate the need for a number of wide-ranging and well-identified reforms, fostering higher productivity of the Portuguese economy in the medium and long run.

ARTICLES III

GOOD (AND NOT SO GOOD) POLICY AT THE ZERO BOUND*

*Sandra Gomes** | João Sousa** | Pedro Teles***

ABSTRACT

The fact that nominal interest rates cannot be negative implies that alternative policies must be considered at the zero bound to provide stimulus, should it be needed. This note is an assessment of fiscal policies at the zero bound. Using a model for the euro area, we illustrate and quantify the effects of fiscal policy responses to a major recession that leads the economy to the zero lower bound on interest rates. First, we show that ad-hoc fiscal policy measures lead to results that are very different from the efficient allocation. Then, drawing on the results in Correia, Farhi, Nicolini and Teles (2011), we show how fiscal policy should be designed to replicate the efficient allocation.

1. Introduction

Nominal interest rates cannot be negative. If they could, people would make arbitrarily large profits just by borrowing and holding money. So when the policy rate is very close to zero, as has been the case in the last three years in the US and other economies, nominal interest rates cannot be further reduced. If further stimulus is necessary, alternative policies must be considered. This note is an assessment of fiscal policies at the zero bound. It draws heavily on work by Correia, Farhi, Nicolini and Teles (2011).

If prices and wages were flexible, the fact that interest rates cannot be negative would be irrelevant for policy. In most models, the zero bound would actually be the optimal policy, the Friedman rule, named after Milton Friedman who first derived it. The argument of Friedman is straightforward. The nominal interest rate, the return on riskless short-term nominal debt, is the opportunity cost of holding money. It is the price of money. Given that the cost of producing money is, if not zero, very close to it, a simple efficiency argument would equate the price of money to its marginal cost, *i.e*. zero. The nominal interest rate should therefore be zero or very close to it. With flexible prices and wages, a zero nominal interest rate does not restrict real interest rates, or real allocations. The real interest rate is the nominal rate minus inflation, and if inflation is not costly, it is always possible to achieve a target for the real rate, at zero cost, through a particular target for the inflation rate. If the real interest rate ought to be negative, say minus 4 per cent per year, this can be done at the zero bound with 4 per cent inflation per year.

Most economists would agree that the swings in inflation rates that would be necessary to achieve good outcomes at the Friedman rule would be hard to implement and, if possible, would come at a cost. They would require synchronized movements in all prices in the economy that, because of information costs or more direct menu costs, would be hard to achieve. The movements in inflation rates would also have to be credible, meaning that future policy would have to confirm them. But most mandates of central banks in the developed world include objectives of price stability, and inflation swings of that order of magnitude would not comply with those mandates.

At the end of 2008, in response to the major events in financial markets in the US and elsewhere, policy rates were lowered to the historically low levels of 0 to 25 basis points in the US. If possible, nominal interest rates would have been further reduced. But they could not be. What are, then, alternative policies?

An obvious candidate is government spending. In Portugal, total government expenditure as a share of GDP was raised from 43.7 per cent in 2007 to 48.1 per cent in 2009. The case of Portugal is striking given the very high levels of public and foreign debt, and the recent history of low GDP growth rates,[1] but this was a common pattern across the world. Still, the evidence on the effects of government spending is controversial, at most. And it is particularly scarce at the zero bound. Models can be used to assess the effects of policy at the zero bound, even if they are not as reliable as one would wish because some of the assumptions, as the ones on price and wage stickiness, are not policy invariant.

There is theoretical and quantitative work on the effects of government consumption on economic activity at the zero bound, as in Eggertsson (2009), Eggertsson and Woodford (2003, 2004a, 2004b) or Christiano, Eichenbaum and Rebelo (2009).[2] They show that the fact that interest rates cannot be reduced is responsible for a much higher multiplier of government spending. Christiano, Eichenbaum and Rebelo (2009), in particular, show that the multiplier on government spending is larger; the larger is the need to use it. In these models there would be no effect on output if government spending was a substitute for private consumption. In fact, the effect on output is larger when government consumption is useless. The analysis is about effects of government consumption on economic activity, not about effects of this on welfare. The effects on welfare, if positive, are much lower.

Correia *et al*. (2011) show that taxes can be used to achieve efficient outcomes. The intuition is simple. Suppose that for some reason, possibly associated with increased uncertainty, agents wanted to save more. If the nominal interest rate was way above the zero bound, then it could be lowered, and, for a stable inflation rate, the resulting low real rates would reduce the incentives to save, preventing consumption, and production, from decreasing. But if the necessary cut on nominal interest rates was very large, then the economy would hit the zero bound. How can real rates be lowered at the zero bound? High expected inflation would bring real interest rates down. But high inflation is hard to implement, because of the need to raise prices of all goods and because it may be hard to convince the public that the central bank would allow for high inflation in the future, even if temporary.

Consider now a policy in which consumption taxes are lowered today to be raised in the future. An expected increase in consumption taxes is future inflation. But it has two advantages relative to inflation in producer prices. Consumption taxes move all prices together keeping producer prices unchanged and, furthermore, it can be credible.

The combination of low consumption taxes today with high consumption taxes in the future can distort the allocation of labour. But there are ways of correcting this. Labour income taxes must be adjusted to compensate for the changes in consumption taxes. Variable consumption taxes also distort the allocation of capital. If they are low today and high tomorrow, capital accumulation becomes relatively expensive and so capital income taxes would have to be lowered to remove that distortion. Finally, payroll taxes may also have to be used to avoid the need for movements in wages that could also be hard to put in place, given the institutional and political conditions.

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1 With a balanced growth rate of $\gamma = 1\%$, a real interest rate of $r^* = 3\%$, and a level of public debt (D) of 85% of GDP, it would be necessary to have a permanent primary surplus of $T - G = \frac{(r^* - \gamma)}{1+\gamma} D = 1.7\%$ of GDP, where T and G stand for government revenue and expenditure, respectively, in order to pay for the debt.

2 See also Gomes, Jacquinot, Mestre and Sousa (2010). They also look at the effects of changes in taxes at the zero lower bound.

Correia *et al.* (2011) show that there is a combination of all those taxes that leads to the same outcomes that could be achieved away from the zero bound, or, alternatively, in a world where prices and wages could be automatically adjusted without cost.

In this article, we are going to play the role of a policy maker unaware of the results in the literature. Our policy maker will use a model that lets him, or her, experiment alternative policies without social costs. The model was developed and estimated to resemble the actual economy, with the aim of answering questions close to the ones we are interested in answering here. It is a version of the Smets and Wouters (2003) model for the euro area, modified to take into account the zero bound constraint on nominal interest rates. We proceed by trial and error, performing different policy experiments. We compare the effects of those policies to the efficient ones, which would be the same ones that would be achieved in an economy without sticky prices or wages.

We are not alone with Correia *et al.* (2011) in proposing these kinds of policies as a way of overcoming the zero bound constraint on nominal interest rates. Martin Feldstein proposed it for Japan back in 2003 (see Feldstein, 2003). Robert Hall and Susan Woodward made similar proposals for the US. There are also sectorial or regional policies aimed at giving agents the incentive to anticipate consumption. As pointed out by Correia *et al.* (2011), the US Consumer Assistance to Recycle and Save (CARS) program and tax holidays at the regional level are examples of these policies.

The remainder of the article proceeds as follows. Next we present a simple model where we illustrate the details of the general results in Correia *et al.* (2011). Then, we proceed to the policy experiments.

2. A simple model

To illustrate the results in Correia *et al.* (2011) we first use a model where there are no frictions in the adjustment of prices and wages. We show that it is possible to conduct fiscal policy at the zero bound on interest rates that achieves efficient outcomes and that does not require prices and wages to respond to aggregate shocks. Since prices and wages do not have to move, the nominal rigidities, that are likely to be present, are not effective. With this kind of policy, the economy with sticky prices and wages behaves in the same efficient way as the economy without price or wage stickiness that we are now going to describe.

The model is deterministic. There are no shocks, but there are still movements over time because productivity moves over time, government spending also moves, and there may also be movements in preference parameters. In the model, there is a representative household and a representative firm. There is also a government.

The preferences of the households depend positively on consumption C_t and negatively on labour N_t,

$$U = \sum_{t=0}^{\infty} \beta^t u\left(C_t, N_t, \xi_t\right) \tag{1}$$

where ξ_t is a time-varying preference parameter.

Government consumption G_t is exogenous. The production technology is

$$C_t + G_t + I_t = A_t F\left(N_t, K_t\right) \tag{2}$$

where K_t is capital and investment I_t is such that

$$K_{t+1} = \left(1 - \delta\right) K_t + I_t. \tag{3}$$

A_t is an aggregate productivity time-varying parameter and the production function has constant returns to scale.

The government finances public consumption with time varying taxes on consumption τ_t^c, labour income τ_t^n, capital income τ_t^k, as well as a payroll tax paid by firms, τ_t^p. We also allow for lump sum taxes, T_t.

The budget constraint of the households can be written as

$$\frac{1}{1+i_t} B_{t+1}^h + P_t K_{t+1} = B_t^h + (1-\delta) P_t K_t + + (1-\tau_t^k) U_t K_t + (1-\tau_t^n) W_t N_t - (1+\tau_t^c) P_t C_t - T_t \quad (4)$$

together with a no-Ponzi games condition. B_{t+1}^h are nominal bonds that cost $\frac{1}{1+i_t}$ and pay one unit of money in period $t+1$. i_t is the nominal interest rate, W_t is the nominal wage and U_t is the rental cost of capital.

The household that maximizes utility subject to the budget constraint must equate the marginal rate of substitution between consumption and labour to the real wage distorted by the consumption and the labour income taxes,

$$-\frac{u_C(C_t, N_t, \xi_t)}{u_N(C_t, N_t, \xi_t)} = \frac{(1+\tau_t^c) P_t}{(1-\tau_t^n) W_t}. \quad (5)$$

The optimal decision on the nominal bonds and capital implies, respectively

$$\frac{u_C(C_t, N_t, \xi_t)}{P_t(1+\tau_t^c)} = \beta(1+i_t) \frac{u_C(C_{t+1}, N_{t+1}, \xi_{t+1})}{P_{t+1}(1+\tau_{t+1}^c)}, \quad (6)$$

and

$$P_t(1+i_t) = \left[P_{t+1}(1-\delta) + (1-\tau_{t+1}^k) U_{t+1} \right]. \quad (7)$$

The firms are competitive. They take prices as given and maximize profits, so that the price of the good must equal marginal cost,

$$P_t = \frac{(1+\tau_t^p) W_t}{A_t F_n\left(\frac{K_t}{N_t}\right)} = \frac{U_t}{A_t F_k\left(\frac{K_t}{N_t}\right)}, \quad (8)$$

where τ_t^p is a payroll tax.

In a competitive equilibrium all these conditions must be satisfied. In addition, the zero bound on nominal interest rates must also be verified so that

$$i_t \geq 0.$$

Efficiency

What are the efficient allocations in this economy? If we were to maximize the utility of the representative household taking into account only the resource constraints (2) and (3), the resulting efficient allocation would be described by the following marginal conditions: the marginal rate of substitution between consumption and leisure would be equal to the marginal productivity of labour, the marginal rate of substitution between consumption today and tomorrow would be equal to the marginal productivity of capital, and total production would be equal to private and public consumption plus capital accumulation:

$$-\frac{u_C\left(C_t,N_t,\xi_t\right)}{u_N\left(C_t,N_t,\xi_t\right)} = \frac{1}{A_t F_n\left(K_t,N_t\right)}, \tag{9}$$

$$u_C\left(C_t,N_t,\xi_t\right) = \beta u_C\left(C_{t+1},N_{t+1},\xi_{t+1}\right)\left[A_{t+1}F_k\left(K_{t+1},N_{t+1}\right)+1-\delta\right] \tag{10}$$

and

$$C_t + G_t + K_{t+1} - \left(1-\delta\right)K_t = A_t F\left(K_t,N_t\right). \tag{11}$$

We now need to show that this efficient allocation can be achieved even if the nominal interest rate is zero, with prices and wages that remain constant, using fiscal policy.

Efficient policy at the zero bound

Let the price level and the aggregate wage be constant, $P_t = P$ and $W_t = W$. In order for an efficient allocation satisfying (9), (10) and (11) to be a competitive equilibrium it would also have to satisfy

$$-\frac{u_C\left(C_t,N_t,\xi_t\right)}{u_N\left(C_t,N_t,\xi_t\right)} = \frac{\left(1+\tau_t^c\right)P}{\left(1-\tau_t^n\right)W}, \tag{12}$$

$$\frac{u_C\left(C_t,N_t,\xi_t\right)}{\left(1+\tau_t^c\right)P} = \left(1+i_t\right)\frac{\beta u_C\left(C_{t+1},N_{t+1},\xi_{t+1}\right)}{\left(1+\tau_{t+1}^c\right)P}, \tag{13}$$

$$P = \frac{\left(1+\tau_t^p\right)W}{A_t F_n\left(\frac{K_t}{N_t}\right)}, \tag{14}$$

$$\frac{W}{A_t F_n\left(\frac{K_t}{N_t}\right)} = \frac{U_t}{A_t F_k\left(\frac{K_t}{N_t}\right)}, \tag{15}$$

$$\frac{u_C\left(C_t,N_t,\xi_t\right)}{\left(1+\tau_t^c\right)} = \frac{\beta u_C\left(C_{t+1},N_{t+1},\xi_{t+1}\right)}{\left(1+\tau_{t+1}^c\right)}\left[1-\delta+\left(1-\tau_{t+1}^k\right)\frac{U_{t+1}}{P_{t+1}}\right], \tag{16}$$

From conditions (12) and (14), we have

$$-\frac{u_C\left(C_t,N_t,\xi_t\right)}{u_N\left(C_t,N_t,\xi_t\right)} = \frac{\left(1+\tau_t^c\right)}{\left(1-\tau_t^n\right)}\frac{\left(1+\tau_t^p\right)}{A_t F_n\left(\frac{K_t}{N_t}\right)} \tag{17}$$

Notice that if we set the joint distortion to zero, $\frac{\left(1+\tau_t^c\right)}{\left(1-\tau_t^n\right)}\left(1+\tau_t^p\right)=1$, then it is possible to satisfy the efficiency condition (9). This is possible because we allow for lump sum taxes that pay for government spending without imposing distortions. Condition (16), together with (14) and (15), can be used to write

$$\frac{u_C\left(C_t,N_t,\xi_t\right)}{\left(1+\tau_t^c\right)} = \frac{\beta u_C\left(C_{t+1},N_{t+1},\xi_{t+1}\right)}{\left(1+\tau_{t+1}^c\right)}\left[1-\delta+\left(1-\tau_{t+1}^k\right)A_{t+1}F_k\left(\frac{K_{t+1}}{N_{t+1}}\right)\right]. \tag{18}$$

There is always some capital income tax, that can respond to the consumption tax and eliminate the intertemporal distortion so that the efficiency condition (10) is also satisfied.

From condition (13), we have

$$\frac{u_C\left(C_t,N_t,\xi_t\right)}{\left(1+\tau_t^c\right)P} = \left(1+i_t\right)\frac{\beta u_C\left(C_{t+1},N_{t+1},\xi_{t+1}\right)}{\left(1+\tau_{t+1}^c\right)P}. \tag{19}$$

If the nominal interest rate is zero, $i_t=0$, there is still a path for consumption taxes that satisfies this condition. Given that the nominal interest rate is zero and the real interest rate could actually be negative, then there must be inflation. Here we are imposing that producer prices are constant. Inflation comes from consumption taxes that will have to increase so that the real interest rate is the efficient one.

The labour income tax must then respond to the changes in the consumption tax to verify condition (12), and the payroll tax must also move to verify condition (14). Condition (15) will be satisfied by a rental cost of capital, and, as we have already mentioned, condition (16) is satisfied by a response of the capital income tax to the movements in the consumption tax.

Policy in normal times

In normal times, the nominal interest rate is positive. This is possible with constant prices and consumption taxes, provided the real rate $\frac{u_C\left(C_t,N_t,\xi_t\right)}{\beta u_C\left(C_{t+1},N_{t+1},\xi_{t+1}\right)}-1$ is positive. The efficient allocation can then be implemented in a simpler way. It won't be necessary to move consumption taxes or the capital income tax. The other two taxes, the labour income and the payroll tax, will still have to move in order to keep prices and wages stable in response to shocks.

Condition (13) will be satisfied by a time varying interest rate. Since prices and wages do not move, the labour income tax will have to move to satisfy condition (12) and the payroll tax will have to move to satisfy condition (14).

Sticky prices and sticky wages

We have analysed a model where prices and wages are flexible. How can we draw conclusions from this analysis that may be relevant in a world where, for many reasons, prices and wages may be slow to adjust? In the model, it was possible to use policy to achieve efficient outcomes by stabilizing prices and wages. If prices and wages are stable, then sticky price or sticky wage restrictions have no impact.

The economy with sticky prices and sticky wages behaves exactly like the one with flexible prices and wages. If it is possible to achieve efficiency under flexible prices and wages, it is also possible to respond optimally to aggregate shocks when prices or wages are sticky.

3. Policy experiments

In this section we use a New-Keynesian model very similar to the one in Smets and Wouters (2003) which is probably the most widespread framework used for policy analysis. It is considerably more complex than the one we used in the section above. Prices and wages are sticky and there is a number of other features that are useful to have it track the data better. We are going to use the model to perform various policy experiments. We proceed by trial and error as if we did not know what the optimal policy is. We do know it and describe it at the end of this section. Meanwhile we increase government spending, cut various taxes and possibly raise some as we lower others.

The model

In the simulations below, we use a closed economy model with a similar structure to that in Smets and Wouters (2003), enlarged to include several taxes and to explicitly take into account the zero bound on interest rates.[3] To calibrate the model we mostly rely on the estimation results in Smets and Wouters (2003).

There are four agents in the economy, households, firms, a fiscal and a monetary authority. Households have preferences over final consumption and leisure with external habit persistence in consumption.[4] Private and public consumption and investment are composite goods aggregating a continuum of differentiated intermediate goods. Households' labour is also differentiated. Labour used for production of each intermediate good is also a composite of the different varieties. Production of each intermediate good uses labour and capital, with variable capital utilization. The technology has constant returns to scale. There are also adjustment costs in investment.

Households set wages as in Calvo (1983), which means that in each period there is a constant and exogenous probability of being able to reoptimise wages. Households that cannot reoptimise partially adjust their wages according to past inflation. Households own physical capital that they rent to firms. They can change their capital stock by investing in new capital and they also decide on the degree of utilisation of installed capital. Households own the firms, receive dividends and hold both state-contingent and noncontingent nominal bonds. The return on these noncontingent bonds is the policy rate of the central bank.

There is a continuum of firms each producing an intermediate good and one representative firm producing the final good, which is the Dixit-Stiglitz aggregator of the continuum of intermediate goods. The final good can be used for consumption (private or public) and investment purposes. The market for intermediate goods is monopolistic competitive and the market for the final good is perfectly competitive.

Intermediate good firms set prices as in Calvo (1983). The firms that cannot change prices partially update prices with previous period aggregate inflation (as in Christiano, Eichenbaum and Evans, 2005).

The government purchases the final good, receives revenue from levying taxes and issues debt. We assume that households pay taxes on consumption purchases, wage income and capital income while firms pay payroll taxes.[5] Finally, the monetary authority's behaviour is assumed to be well described by a

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3 See Woodford (2003) for a detailed discussion of these models.

4 External habit means that the habit formation depends on past aggregate consumption rather than the individual consumer's past consumption. This allows for hump shaped responses of consumption to different shocks which is a feature of the data.

5 There are also lump sum taxes (or subsidies) on households.

Taylor rule outside the zero bound. The interest rate reacts to inflation deviations from target and output growth, and there is interest rate smoothing.[6]

3.1. The great recession

To induce a recession we assume, as in Eggertsson (2009), that there is an exogenous change in house-holds' preferences that induces them to save more[7] and therefore reduce consumption. We also assume that there is an exogenous increase in the cost of installing capital that depresses investment.

These shocks hit the economy in period one and then vanish slowly according to an autoregressive process. After around four years the shocks have basically died out. The combination of the two shocks implies a reduction of consumption of about 2 per cent and a 8 per cent contraction in investment in the first year after the shock, of comparable order of magnitude to the 2009 contraction in euro area private consumption and investment.[8]

The shocks imply a fall in inflation lasting for one year. Given the considerable contraction in economic activity, the nominal interest rate is cut, hitting the zero bound and remaining there for five quarters. The fact that the nominal interest rate cannot fall below zero implies that the central bank is prevented from providing further stimulus via the interest rate. As deflation sets in, the real interest rate rises which contributes to deepening the recession.

3.2. Fiscal policy I

As in Gomes *et al.* (2010) we simulate the scenario where the economy reaches the zero lower bound and consider different fiscal policies that may overcome its effects. The results are different depending on the particular policy.

We first consider a persistent increase in government consumption and a persistent cut in the consumption tax, the labour income tax, the tax on capital income, and the payroll tax, one at a time. The initial increase in government consumption is 2 per cent of steady-state output, and the initial reduction in each tax rate would reduce steady-state revenue also by 2 per cent of output. The spending and tax changes first occur in the quarter when the recessionary shocks hit. Thereafter we assume a gradual return of the instruments to their long-run equilibrium levels.[9] The policy changes are displayed in chart 1 and the results of these simulations are summarised in chart 2.

We first simulate an increase in government spending. The measure alleviates considerably the contraction in output but the fall in consumption and investment is not significantly reduced. Thus an important part of the improvement in output is due to government consumption. This policy reduces the time spent at the zero bound as inflation drops by less than in the no fiscal response case.

We then proceed by lowering taxes. The cut in the consumption tax is also successful in lessening the output contraction, but in this case the drop in consumption is much reduced. The fact that consumers know that the tax is lower today than in the future motivates them to anticipate consumption. The measure is the one that leads to the lowest drop in consumption but investment still drops considerably.

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6 This rule is different from the one in Smets and Wouters (2003), where the interest rate reacts also to the output gap, defined as deviations of actual output from the output that would prevail in a flexible price and wage economy and also to changes in inflation. We also take a lower degree of interest rate smoothing as this helps us in making the zero lower bound constraint binding.
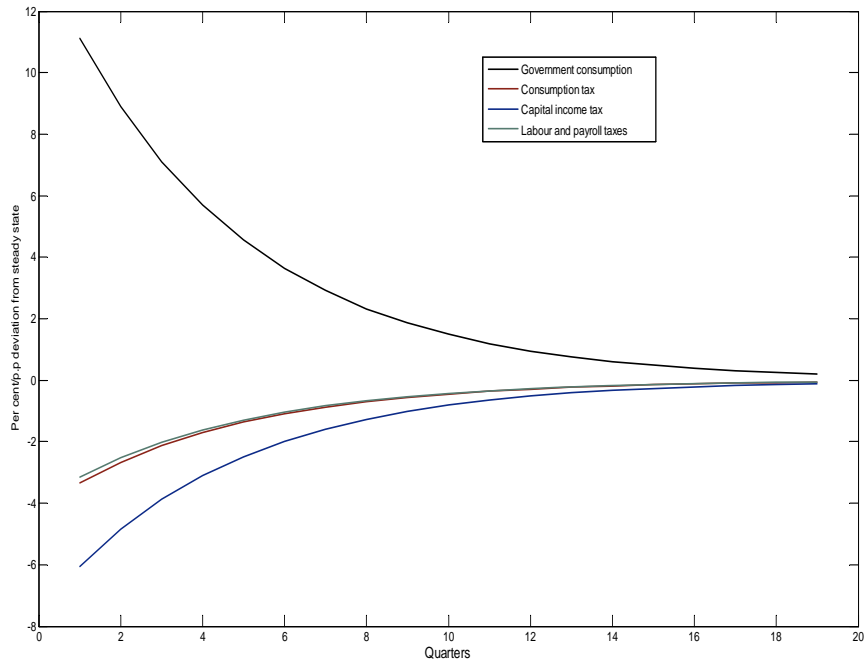
7 Possibly because of increased uncertainty and higher precautionary savings.

8 Implicitly assuming policy did not react.

9 After four years the fiscal policy instruments have basically returned to their steady-state level.

Chart 1

FISCAL SHOCKS EQUIVALENT TO 2 PER CENT OF GDP (*EX-ANTE*)

The remaining taxes don't have a considerable impact on either consumption or investment and as such on output. The time spent at the zero bound is not significantly reduced. In fact, the reduction of the payroll tax actually lengthens the period over which the zero bound constraint is binding (to 6 quarters). This is so because the reduction in this tax implies a significant fall in firms' marginal costs and therefore induces them to reduce prices. The resulting deflationary effect is stronger than in the case of no fiscal response. Therefore, a monetary authority following a Taylor rule will want to cut interest rates more aggressively and as such hits the zero bound for a longer period.
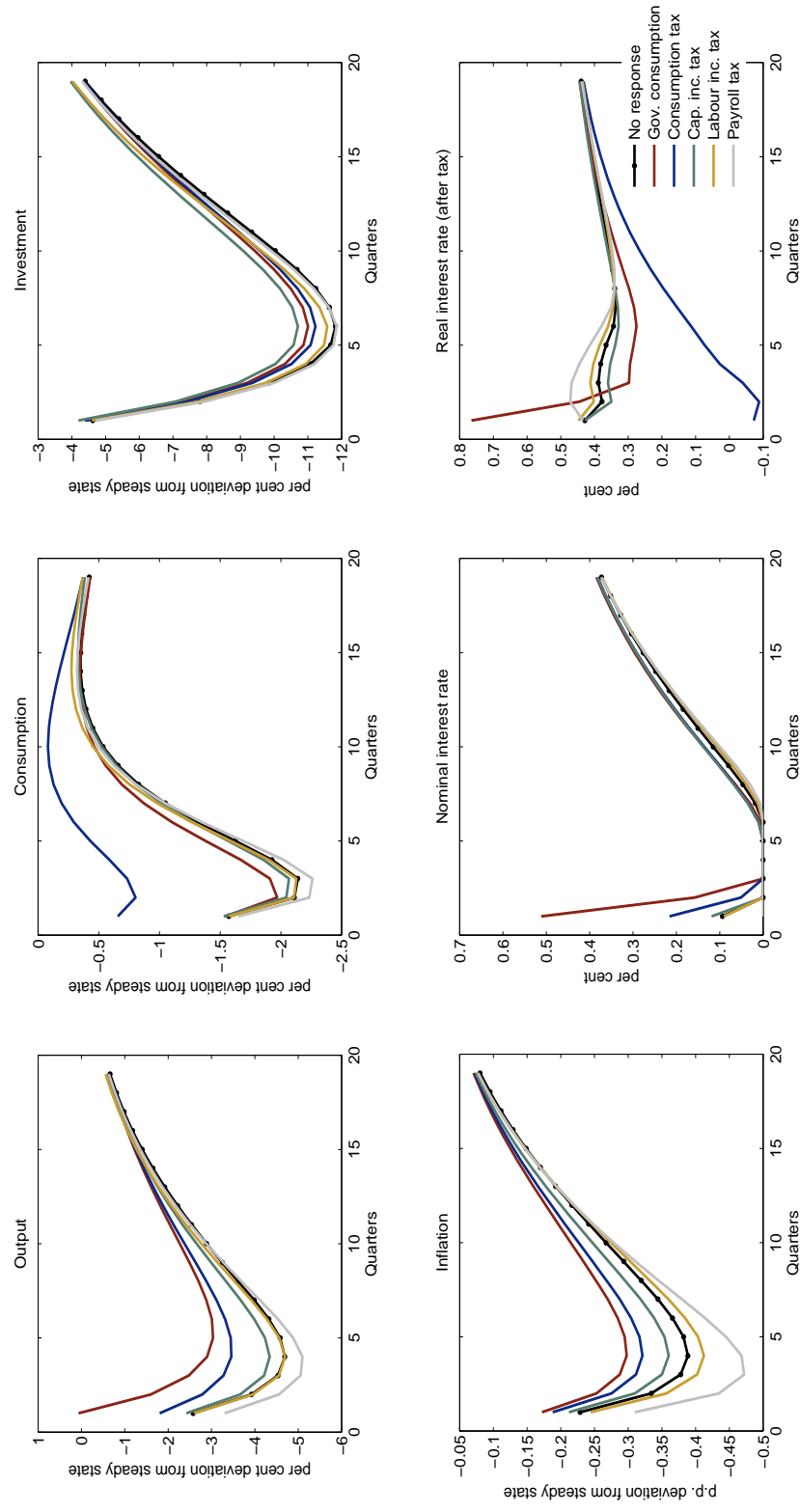
3.3. Fiscal policy II

The most successful of the above tax policies in countering the downturn in both output and consumption is the change in the consumption tax. The reason is that it changes the intertemporal incentives for saving. But a cut in consumption taxes also has deflationary implications. In fact wages can be lower and prices too. A higher labour income tax has the opposite effect on inflation. We now experiment cutting the consumption tax and raising the labour income tax. This has another advantage: the scenarios described above imply either a decline in revenue or an increase in spending by the fiscal authority. We can design an experiment in such a way that the impact on the primary deficit would be zero if applied to steady-state level.

We start by decreasing the consumption tax and increasing the labour income tax. We consider changes in the taxes that, if applied to the steady state levels, would not affect tax revenue. Because the policy is revenue neutral (at the steady state) we can increase the magnitude of the changes in both taxes. We therefore simulate a change that is twice as large as the ones described in the previous section, so the effect on steady-state revenue of each tax is equivalent to 4 per cent of output. The results (Chart 3)

Chart 2

ALTERNATIVE FISCAL INSTRUMENTS

Legend:
- No response
- Gov. consumption
- Consumption tax
- Cap. inc. tax
- Labour inc. tax
- Payroll tax

Output — per cent deviation from steady state — Quarters

Consumption — per cent deviation from steady state — Quarters

Investment — per cent deviation from steady state — Quarters

Inflation — p.p. deviation from steady state — Quarters

Nominal interest rate — per cent — Quarters

Real interest rate (after tax) — per cent — Quarters

show that this experiment has a positive impact on consumption that in the short run actually implies an expansion, but it also reduces investment relative to the "no fiscal response" scenario. The final outcome in terms of output is a smaller contraction, which ends up being of a similar order of magnitude to the best scenario (in terms of output) of the single instrument policy increases, *i.e.*, the increase in government spending. Inflation shows a much smaller decline which, together with the impact on output, implies that the monetary authority cuts the interest rate by much less and so interest rates no longer hit the zero lower bound.

As mentioned, this revenue neutral policy is bad for investment, so in order to deal with this we could lower the capital income tax. But to keep this experiment revenue neutral at the steady state, we have to redesign the change in the consumption and income taxes. We started by reducing the consumption tax rate and increasing the labour income tax rate by the same amount. However, given that the labour income share in output is higher, but very close, to that of consumption, this gives us very little margin to decrease the capital income tax and so the end result is similar to the previous case when the capital income tax change is zero. It is actually hard to distinguish the two curves in chart 3.

From these experiments, we would conclude that, while revenue neutral tax policies can help reduce the recession and obtain a better outcome in terms of consumption, they cannot achieve large effects on investment. We now allow for temporary budget deficits.

3.4. Fiscal policy III

We maintain the previous policy of a decline in the consumption tax, matched by an increase in the labour income tax, so that the policy change would be revenue neutral in the steady state. On top of that, we lower the capital income tax by an amount equal to 6.4 per cent of steady state output. This obviously implies a sizable increase in the deficit, but that is comparable to the ones observed during this crisis. This policy amounts to a reduction of around 8.3 p.p. in the consumption tax rate and an increase of 7.9 p.p in the labour income tax rate, as well as a reduction to basically zero of the capital income tax rate. The results, depicted in chart 3 (corresponding to "lower change in capital income tax" case in the charts), show that this goes a long way in the right direction in offsetting the contraction in investment.

We proceed by further reducing the tax on capital taking the deficit to very high levels. We keep the changes in the other two tax rates. We succeed in reducing the fall in investment (corresponding to the "higher change in capital income tax" case in the charts). The tax rate on capital income would be negative, meaning that investment would be subsidized. It should be noted that these measures seem to constitute an improvement relative to an increase in government spending, in particular regarding the effect on consumption.

3.5. Efficient policy

In the experiments above we proceeded by trial and error. But we know, from Correia *et al*. (2011), that it is possible to use tax policy to achieve full efficiency, overcoming the zero lower bound on nominal interest rates.

The changes in taxes in the model economy that would allow to overcome the zero bound and achieve the efficient allocations, which would be the ones under flexible prices and wages, are displayed in chart 4. To achieve the efficient allocation, the consumption tax would have to be increased over time in order to generate (after-tax) consumer price inflation.[10] But increasing taxes tomorrow relative to today distorts

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[10] It should be noted that we chose to start the simulations from the steady state. An alternative implementation would have the consumption tax rate fall on impact and increase back to the steady state, as in the simulations in the previous sections.
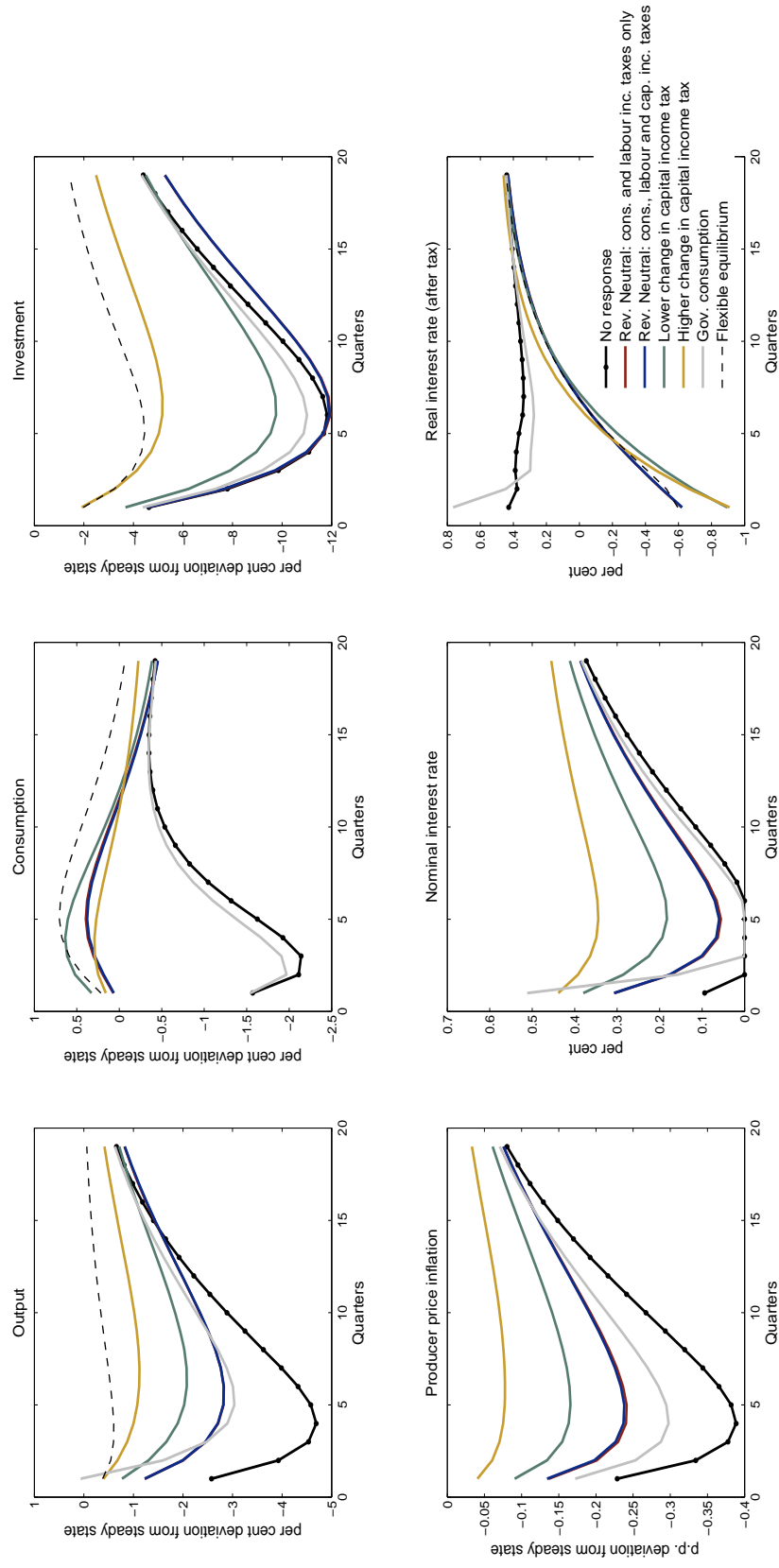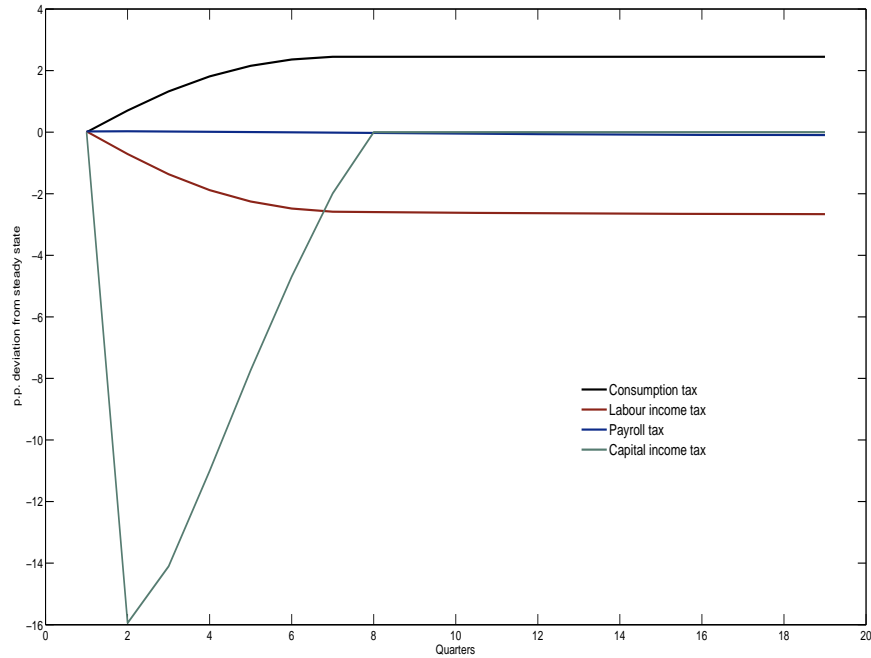
Chart 3

COMBINATIONS OF TAXES

Output

Consumption

Investment

Nominal interest rate

Producer price inflation

Real interest rate (after tax)

— No response
— Rev. Neutral: cons. and labour inc. taxes only
— Rev. Neutral: cons., labour and cap. inc. taxes
— Lower change in capital income tax
— Higher change in capital income tax
— Gov. consumption
- - - Flexible equilibrium

Chart 4

OPTIMAL RESPONSE OF TAXES

the allocation of labour and capital, so that labour income taxes would have to be lowered accordingly and the tax on capital would also have to be cut. As we could suspect from the results in the previous section, the decline in the capital income tax rate would still have to be sizeable (from 20 per cent in steady state to around 4 per cent in the quarter when it reaches its lower level) but now more manageable. Finally the payroll tax paid by firms would have to marginally adjust to avoid movements in prices.

The response of the economy under flexible prices and wages is displayed in chart 3. As mentioned before, the revenue neutral experiments go in the right direction and as such put the economy closer to the efficient allocation except in the case of investment. In the case of flexible prices and wages investment declines by much less and consumption actually increases in the first periods. Output falls less than in all the other simulations. In order to also achieve a response of investment that is much closer to the efficient one, the reduction in the capital income tax would have to be extremely large and therefore the negative impact on the primary budget is sizeable.

4. Final remarks

In this article, we have illustrated how the recent findings in Correia *et al*. (2011) can be used to guide fiscal policy responses to a major recession that leads the economy to the zero lower bound on interest rates. We show that arbitrary fiscal policy leads to results that are far away from the efficient allocation and that, given the model used and the shocks hitting the economy, the required changes in taxes are conceivable in a crisis period. However, the changes in taxes are sensitive to the specific shock hitting the economy (as is optimal monetary policy away from the zero bound) and there is a temporary deterioration of the government budget balance.

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FISCAL POLICY IN A SMALL EURO AREA ECONOMY*

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ABSTRACT

This article discusses the role of fiscal policy in a small open economy of the euro area. In the context of a general equilibrium model, results suggest that fiscal policy can play an active role in stabilising the business cycle, having effects on production and households consumption. The analysis of the impact of fiscal measures should not, however, focus exclusively on its short-run effects, ignoring the medium-run impacts of the exit strategies necessary to ensure a sustainable path of public debt. Results suggest that, if fiscal stimulus measures are implemented, these should be temporary and that the adequate time lag to return to the initial fiscal stance depends, among other factors, on the evolution of the sovereign debt risk premium.

1. Introduction

This article discusses the role that fiscal policy can play in a small open economy integrated in a monetary union. The analysis is based on results obtained in Almeida, Castro, Félix and Maria (2010a, 2010b), in the context of a general equilibrium model called *PESSOA*. There are several reasons to use this type of models, among which the separation of economic impacts throughout several time horizons, divided by different markets, as well as the formal identification of the main transmission channels.[1]

The analysis of the effectiveness of fiscal policy instruments is usually centered on its immediate or short-run effects. However, the macroeconomic impacts of fiscal programs go beyond that horizon, namely due to the need of ensuring a sustainable path for public debt. In this article it is assumed, in particular, that the authorities announce with credibility that they intend to recover the initial fiscal stance, existing before the implementation of the fiscal programs, whether they are of a temporary or permanent nature. The analysis presented in this article also focuses on the macroeconomic impacts of alternative exit strategies, which may take place during different time horizons, and bring about changes in the sovereign debt risk premium.

The next section presents *PESSOA*, in a stylised and succinct way, with emphasis on the role of the government and households, and describes the fiscal program. Section 3 presents the macroeconomic implications of alternative fiscal policy measures. Section 4 evaluates the macroeconomic impact of alternative exit strategies that always garantee that the fiscal stance is paleced back in its initial position. Finally, section 5 presents the main conclusions.

1 A comparative analysis using general equilibrium models can be found in Cwik and Wieland (2010) and Coenen, Erceg, Freedman, Furceci, Kumhof, Lalonde, Laxton, Lindé, Mourougane, Muir, Mursula, de Resende, Roberts, Röeger, Snudden, Trabandt and in't Veld (2010).

2. *PESSOA*: A general equilibrium model

The role that fiscal policy can play in a small open economy of the euro area is analysed in a context of a general equilibrium model named *PESSOA* (Almeida *et. al.*, 2010c), created and calibrated to incorporate the distinct elements of an economy with these characteristics. As in Adolfson *et al.* (2007), it is assumed that the external environment is imune to developments in the small open economy. In the case of an economy integrated in the euro area, this assumption implies that domestic shocks do not affect monetary policy decisions. In this context, nominal stability is ensured by assuming perfect credibility of the inflation target, set by the ECB in the case of the euro area. Dynamic stability, in turn, is ensured by the adjustment of international trade to fluctuations of the real exchange rate, in a context where the nominal rate is irrevocably fixed and is fully credible. To use an expression from Giavazzi and Paganno (1988), the small open economy in *PESSOA* is effectively "tying its hands" with the rest of the euro area members.

PESSOA closely follows the Global Integrated Monetary and Fiscal Model (Kumhof, Muir, Mursula and Laxton, 2010). Households are non-Ricardian, following the overlapping generations model with stochastic finite lifetime proposed in Blanchard (1985) and Yaari (1965). This enables a more realistic response of economic agents to fiscal policy shocks than the one obtained in an infinitely lived framework. The model is intrinsically New-Keynesian, assuming monopolistic competition and nominal rigidity in both the labour and product markets – a distant context from the perfect competition assumption. Furthermore, the model incorporates elements of real rigidity to obtain realistic responses of investment and imports.

Section 2.1 presents *PESSOA* in a succinct and stylised way. Special attention is paid to the behaviour of households and the Government, and in particular to the non-Ricardian features of the model, in order to thoroughly evaluate the role that fiscal policy can have in an open economy of the euro area. A more detailed presentation of the model, the formal optimisation problems of economic agents, as well as the calibration can be found in Almeida *et al.* (2010a, 2010b and 2010c). Section 2.2 presents in a stylised way the different fiscal programs.

2.1. The model

Chart 1 presents *PESSOA* in a stylised way, giving special attention to some key elements. On the one hand, the different economic agents that compose the domestic economy are presented (numbered from 1 to 4). These agents exchange among themselves labour services, intermediate and final goods, as well as income flows including labour income, firms dividends, tax payments and Government transfers to households.

On the other hand, Chart 1 highlights that decisions of agents 1 to 4 are conditioned by an external environment that, as already mentioned, is not influenced by any circumstance. For simplification, it is assumed that the external environment corresponds to the remaining euro area countries. The connection between the domestic economy and the rest of the world is achieved through imports and exports of goods and services, as well as the purchase of foreign assets/debt by domestic households, which are confined to households that have access to asset markets (1a. in Chart 1).

Chart 1 also illustrates the fact that *PESSOA* is a dynamic model that converges in the long run to a steady state. The growth of economic activity in the long run only depends on the deterministic increase of technological progress, in a context where it is assumed that there is no population growth. The steady state consists of a stable and long-lasting equilibrium of macroeconomic aggregates. Note that in a general equilibrium model, the economy is in equilibrium in all periods, including each and every adjustment period (since demand is equal to supply in all markets in all periods). However, after a shock, the economy goes through a transition period with a sequence of temporary equilibriums, until the stationary state is again reached. These transitory equilibriums are a result of an optimising behaviour

Chart 1

PESSOA
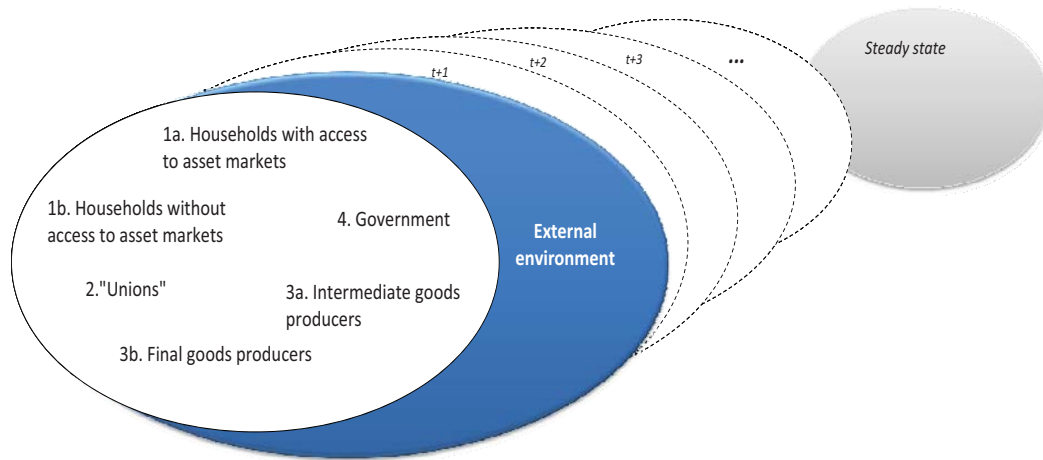
by agents 1 to 3, who use all information available and anticipate the future evolution of all relevant variables. More precisely, any change of policy in a given moment t, such as a tax reduction to stimulate the economy, implies a sequence of effects that implies that the economy has to go through a set of temporary equilibriums (at moments $t+1$, $t+2$, etc.) until it reaches a new steady state. In the case of changes of a temporary nature, after the adjustment period, whose duration fundamentally depends on the degree of real and nominal rigidity, the economy returns to its initial steady-state. The mechanisms that ensure the dynamic stability of the model, i.e., convergence to a new well-defined steady state, are essentially rooted in the adjustment of prices and wages, which determine in each and every moment the real exchange rate, and in the interaction of this adjustment with the goods and assets flows with the rest of the euro area.

Households have stochastic finite lifetimes, facing an instant probability of death in line with the overlapping generations scheme proposed by Blanchard (1985) and Yaari (1965). Through an insurance contract, the surviving households receive in every moment the assets of the households that die. This framework turns the behaviour of these agents intrinsically non-Ricardian. If the Government finances a fiscal stimulus program through public debt issuance, for example, the future generations will be charged with the necessary taxes to pay that debt (which was created before these generations were born). The surviving families, in turn, by receiving assets from households who died, accumulate more assets than their future fiscal responsibilities, which they consider net wealth, therefore affecting their consumption decisions. In the case of a fiscal stimulus program, households prefer that its financing is done by debt issuance instead of an immediate tax increase. The reason is simple: issuing debt implies that the fiscal program is partly financed by future generations. The existence of a non zero probability of death implies that households who benefit today from the effects of the fiscal program and survive will finance it in an amount that is inferior to their debt liabilities.[2]

PESSOA considers two types of households: the asset holders, who can access asset markets and perform both intra and inter-temporal optimisation, smoothing out their consumption over lifetime by trading

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2   The "probability of death" seen as physical death is not the only classification used in the economic literature for this probability. Alternative designations include "economic probability of death" or "degree of myopia" of households (Frenkel and Razin 1996, Harrison, Nikolov, Quinn, Ramsay, Scott and Thomas 2005, Bayoumi and Sgherri 2006).

assets (called "1a. Households with access to asset markets"); and households that do not access asset markets and are, therefore, limited to intra-temporal optimisation (households 1b). Both types of households extract utility from consumption and leisure, through a constant relative risk aversion utility function. Furthermore, the existence of "unions" is admitted, on which households delegate wage negotiation. Labour market institutions generate monopolistic competition conditions, with "unions" using their market power to charge firms a wage higher than the marginal rate of substitution between consumption and leisure, generating a wage premium that is appropriated by households. Households with access to debt markets are able to accumulate wealth and hold debt in the course of their lives, contrary to families without access to asset markets. These are a second source of non-Ricardian behaviour, since that, by not being able to reaffect consumption intertemporarily, they limit themselves to consuming all of their income in each period, being therefore extremely sensible to the implementation of fiscal programs and their financing. The importance of this type of agents in the obtainance of realistic responses of private consumption to fiscal stimulus is presented in Galí, López-Salido and Vallés (2007).

Househods behaviour in *PESSOA* contemplates a life-cycle income profile, although in a very rudimentary way. This translates into a wage income adjusted by the labour productivity level of each generation, admitting that the younger generations are more productive than the older ones (a constant labour productivity rate of decay is considered). This assumption amplifies the non-Ricardian effects, since a change in the labour income tax generates a differentiated effect between generations, yielding more revenues from younger generations, which are more productive and have, therefore, higher wage income than from older generations.

The Government can use a diversified set of fiscal policy instruments. Revenues and spendings are detailed in Table 1. Besides consuming a specific final good, highly intensive in non-tradable intermediate goods, the Government performs transfers to households. To finance its activity, the Government charges taxes over labour income (which includes not only the labour income tax but also contributions paid by employers), households consumption and firms dividends. In addition, the Government charges firms benefits from transfers from abroad. Taxes are distortionary, being an additional source of non-Ricardian behaviour. The policy options that will be evaluated in this article are based on the macroeconomic effects of five instruments: public consumption (G), transfers to all households (TRG), transfers to households without access to asset markets (TRG^B), taxes over labour income (Γ_l) and taxes over households consumption (Γ_c).

To postpone the necessary tax collection to finance expenditures, the Government can issue one period bonds, paying an interest rate over the stock of bonds held by households (type 1a in Chart 1). It is assumed that all bonds issued by the Government are held by domestic households, which can, however, buy debt from the rest of the world. The domestic interest rate differs from the rest of the euro area interest rate due to the existence of a risk premium, which can fluctuate with the degree of Government debt relative to its long-run level. Since the domestic economy is sufficiently small, changes in the international investment position (IIP) of the small open economy have no impact on the interest rate of

Table 1

PUBLIC SECTOR IN *PESSOA*	
Spending	**Revenues**
Government consumption (G)	Consumption taxes (Γ_c)
Transfers to all households (TRG)	Labour income taxes (Γ_l)
• Without access to asset markets (TRG^B)	
• With access to asset markets	
Interest outlays	Contributions paid by employers
	Dividends tax
Fiscal Balance (Global Balance)	Transfers from the EU

Notes: Government consumption (G) includes public sector investment spending; interests are on the stock of public debt.

the euro area. Contrary to models where households are infinitely lived, the long-run IIP is determined endogenously in models with finite lifetime households (Frenkel and Razin 1996, Harrison *et al.* 2005).

Modelling a small open economy combines the necessary complexity that allows the model to be useful for the conduction of economic policy with sufficient simplicity for the model to be analytically and computationally tractable. For example, the determination of the various macroeconomic equilibriums is conditioned by a strong budgetary discipline, which, although allowing authorities to choose between several options, eliminates the possibility of unsustainable trajectories of public debt. Notwithstanding, *PESSOA* is – like any economic model – a simplified representation of the real world. The assumption of perfect foresight by households and firms (agents 1 to 3 in Chart 1) may be seen unrealistic, since there are limits to the formulation and solution of complex problems, either due to the quantity of necessary information, or to the incapacity of processing and computing the utility of each alternative action in order to guarantee the optimal choice. Furthermore, the absence of a financial block that interferes with the decisions of economic agents, the inexistence of involuntary unemployment, or of externalities associated with distinct public expenses (for example in the justice, health and education sectors), as well as the impossibility of considering effects over the distribution of households income, are other examples of the model limitations.

2.2. A stylised fiscal program

Chart 2 presents a sequence of dates and economic policy measures that illustrate the fiscal programs presented in the next sections of this article. As an example, an increase in public consumption (G) is considered.

Chart 2 presents three relevant dates: t_0, t_1 and t_2. By assumption, all dates are separated by four quarters. The first date - t_0 - indicates the quarter in which the authorities announce and implement the fiscal program. Before t_0 it is considered that public consumption was at its stationary level, which is defined in Chart 2 as G^{SS}. If the program is temporary, then there is a date, t_1, after which public consumption goes back to its initial level, G^{SS}. On the contrary, if the increase in public consumption is permanent, then nothing happens in t_1 and the new level is given by $G^{SS} + \Delta$. The level Δ represents the dimension of the stimulus program. The obtained macroeconomic effects are conditional on the assumed profile of the fiscal program.[3]

The method usually used to evaluate the macroeconomic effects of fiscal instruments is centered in the impact multiplier (Blanchard 2002, Canova 2007). This indicator, hereafter designated by impact multiplier, is defined as the ratio between the change in the variable of interest in the first year (which corresponds to the time period between t_0 and t_1 in Chart 2) and the ex ante change in the same period of the fiscal balance. Without loss of generality it has been considered that the dimension of the stimulus always represents 1 per cent of the *ex ante* GDP stationary state, independently of the fiscal instrument used by the authorities.

The context of a general equilibrium analysis requires the maintenance of a sustainable trajectory of public debt. To ensure this trajectory, *PESSOA*, like most general equilibrium models with Government, includes a fiscal policy rule that determines in each period the public sector fiscal balance. The rule used in this article is based on the assumption that the Government sets clear and credible fiscal goals to which it is commited. In line with Kumhof *et al.* (2010), the rule has the following functional form:

$$Fiscal\ balance = Fiscal\ balance^{LR} + d_1 \times Revenue\ gap + d_2 \times Debt\ gap$$

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3 There are other options in the literature, such as an increase in G at t_0, followed by a gradual reversion or a profile that represents a program that has effectively been announced (Furceri and Mourougane 2010, Cogan, Cwik, Taylor and Wieland 2009).

Chart 2

A FISCAL STIMULUS BASED ON PUBLIC CONSUMPTION
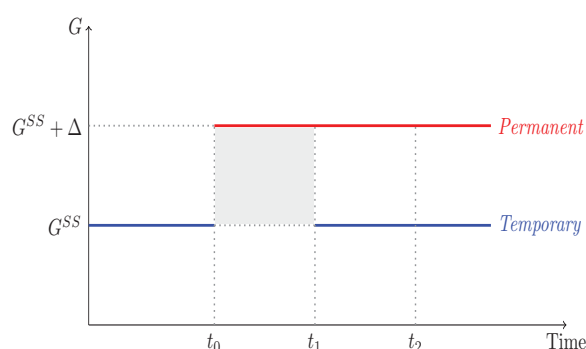
where d_1 is the parameter that characterizes the pro-cyclical or contra-cyclical nature of fiscal policy and d_2 is the parameter that determines the velocity of reestablishment of the long-run fiscal objectives. A value of parameter d_1 below (above) one determines a pro-cyclical (counter-cyclical) fiscal policy, while a higher value of d_2 implies a lower tolerance by the authorities to deviations relative to the fiscal objectives and consequently has a faster exit strategy. While in practice the Government performs adjustments that tend to affect several items, it is usual to assume in this type of models, for clarity and simplicity, that only one item is adjusted. In this article, it has been chosen to endogenize the labour income tax rate τ_t , in light of what has been done in other models (Kilponen and Ripatti 2005, Kumhof and Laxton 2007). Holm-Hadulla, Leiner-Killinger and Slavík (2011) present empirical evidence that establishes a positive correlation between public debt (and interest payment) and labour taxes.

In a general equilibrium and perfect foresight context, all agents in the economy know and take as credible that the tax rate will only reach its stationary level when the two gaps in the rule are zero. This rate is therefore changed every time that cyclical conditions determine fiscal revenue levels that deviate from the levels that would prevail if the tax bases were in their stationary long-run values or when the public debt to GDP ratio deviates from its values in the stationary state. The existence of this rule ensures that in the stationary state the public debt to GDP ratio stabilises in a level pre-defined by the authorities and that the public sector fiscal balance is determined univocally, for each level of the interest rate and of nominal GDP growth.

Whether we are dealing with a temporary or permanent increase of public consumption, an adjustment of the public sector account will always have to occur (see Table1), to guarantee the return to a stationary state (see Chart 1), consistent with the objectives previously announced by the authorities. In the fiscal programs considered in this article it has been admitted that the fiscal policy rule is deactivated until date t_2 of Chart 2, i.e., eight quarters after the beginning of the implementation of the program (in t_0). In the case of a temporary stimulus, this date occurs after the period in which the program is in place in order to avoid an eventually paradoxal situation where the Government on the one hand promotes a fiscal stimulus and on the other hand, simultaneously, takes measures to correct the unbalance generated by that stimulus.

3. Macroeconomic impacts of fiscal policy

This section addresses the following questions under the assumption of perfect credibility: how effective is fiscal policy in a small open economy of the euro area? What instrument should be used to stimulate economic activity or the major components of demand, for example, household consumption? What are the medium and long-term effects of fiscal policy? Should the fiscal stimulus measures be permanent or temporary?

Section 3.1 presents the short-term macroeconomic impacts of temporary fiscal policy measures based on the instruments identified in Table 1. Section 3.2 focuses on the medium-term effects. Section 3.3 analyzes the macroeconomic effects of permanent fiscal policy measures, assuming that the budget deficit and public debt objectives remain unchanged.

3.1. Temporary program: short-run effects

Table 2 reports the impact multipliers obtained with *PESSOA* for a relatively diverse set of macroeconomic variables, based on: (i) a temporary and fully credible fiscal stimulus program, (ii) an ex ante deterioration of the budget balance of 1 percent of the initial steady state GDP, and finally, (iii) a fiscal policy rule that, relying exclusively on the endogenization of the tax rate on labor income Γ_l, guarantees that the public debt goes back to the level that prevailed before implementing the program.

The results show that all options have a positive impact on GDP, as well as on private consumption. The outcome thus suggests that fiscal policy in a small open economy integrated in the euro area can be effectively used for the purpose of macroeconomic stabilization. Additionally, a fiscal stimulus that represents 1 percent of GDP in the first year causes an increase in GDP, in most cases, less than 1 percent. This result implies that a reduction in revenues or an increase in government expenditures may end up being channeled in the first year for an increase in savings or imports. In contrast with the traditional Keynesian multipliers, the reported below unity multipliers are in line with several DSGE models (Cwik and Wieland 2010). Hall (2009) argues that the Keynesian assumption of no restrictions in the aggregate supply of the economy helps to explain the multipliers associated with those traditional models.

All impact multipliers on households consumption are positive, regardless of the fiscal program, in contrast to what happens in models with purely Ricardian households. This is partly explained by the use

Table 2

IMPACT MULTIPLIERS OF ALTERNATIVE FISCAL PROGRAMS | PERCENTAGE DEVIATIONS FROM THE INITIAL STEADY-STATE; INFLATION, IIP AND PUBLIC DEBT, DIFFERENCES IN PERCENTAGE POINTS					
	Government consumption (G)	Transfers to all households (TRG)	Target transfers (TRG^s)	Labour income tax rate (Γ_l)	Consumption tax rate (Γ_c)
GDP	1.02	0.24	0.57	0.37	0.38
Private consumption	0.90	0.78	1.86	0.71	0.96
Public consumption	4.37	0.00	0.00	0.00	0.00
Private investment	-0.62	-0.18	-0.40	0.06	-0.09
Exports	-0.66	-0.32	-0.78	0.06	-0.19
Imports	0.65	0.29	0.71	0.29	0.37
Hours	1.66	0.23	0.63	0.48	0.40
Real wage	0.94	0.42	1.04	-0.79	1.56
Real exchange rate	-0.27	-0.13	-0.31	0.02	-0.08
Inflation	0.29	0.09	0.22	-0.03	-1.62
IIP	-0.02	-0.03	-0.08	0.69	-1.07
Public Debt	0.12	0.46	0.18	-0.11	1.21

Source: Authors calculations.

Notes: The real exchange rate is an indirect quotation and is calculated based on the prices of tradable goods. Inflation used to calculate the real wage, is calculated based on prices of consumer goods paid by households. The results are conditional on the values used to calibrate *PESSOA*.

of public debt issuance to finance the fiscal program. Given the probability of death of households, some of this debt is paid only by future generations. Since these future generations have to pay more income taxes in the future, current generations have an incentive to consume that would not exist if they had to bear the taxes needed to pay the entire debt that has been issued. The multipliers on consumption are slightly amplified by the existence of families that, in each period, consume all disposable income.

The highest impact multiplier on GDP is the one based on public consumption. In this case, a fiscal balance deterioration of 1 percent of GDP, which implies an increase of about 4.5 percent of government consumption ex ante, has an impact of around 1 percent of GDP. In the case where the stimulus is based on transfers to households without access to asset markets the impact is 0.6 percent. If based on a reduction of taxes on income or consumption, the impact is 0.4 percent. Finally, the smallest impact is achieved through an increase in transfers to all households (0.2 percent). The results thus suggest that if the goal of authorities is to stimulate GDP, the fiscal instrument that is more efficient to achieve it is public consumption. This result will justify the use of this instrument in the subsequent sections of this article.

A major reason behind the different magnitudes of the impact multipliers is the fact that stimulus associated with transfers or taxes have an effect on aggregate demand that is largely indirect. The main transmission channel of transfers and taxes is associated with the evolution of disposable income and households wealth. The effect on GDP is reduced in these two cases because, on the one hand, in the case of households with access to asset markets, part of this income will be saved and used to cope with higher taxes in the future. On the other hand, a greater flow of real imports should be expected, since the import content of final goods consumed by households is greater than that associated with public consumption. If public consumption is used as an instrument to stabilize the cycle, the effect on demand is direct. Additionally, there is an indirect effect that results from the increase in labour income due to rising wages associated with higher demand for labour-intensive goods.

If the goal of authorities is to stimulate private consumption, not GDP, results presented in Table 2 suggest that the most effective instrument to achieve it is to increase transfers to families who lack access to asset markets (which will also have a noticeable effect on GDP). The increase in transfers to all families has less impact, as part of the increased income of households with access to the asset markets will be saved in the period when the public expenditure is made.

The effects on investment are imminently negative, except in the case of a temporary reduction of the labour income tax Γ_t[4]. This development mainly reflects a reduction in investment expenditure in a context in which agents anticipate a fall in prices of capital goods and realize the temporary nature of the shock after the initial inflationary impact. Additionally, the increase in prices of domestic production determines a real appreciation, which negatively affects competitiveness and medium-run perspectives, despite the initial impact. Investment is subject to real adjustment costs and therefore tends to react more to developments in the medium and long term than to temporary increases in demand.

The authorities responsible for the conduct of fiscal policy in a small open economy integrated in the euro area cannot ignore the effects that their different options have on prices. Thus, measures to increase government spending tend to lead to price increases, while tax reduction measures involve less relevant impacts on prices and on competitiveness. It should be noted that although a reduction in taxes on consumption implies a significant decline in consumer prices, its impacts on other prices and on competitiveness are limited.

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4 The negative impact on investment is in line with the results obtained in other DSGE models (Cwik and Wieland, 2010). However, in most DSGE models monetary policy is available, since the economy does not integrate a monetary union and the fall in investment reflects an increase of the real interest rate driven by an increase of the nominal interest rate. In *PESSOA*, the increase of the real interest rate reflects expectations of price decreases, after an increase in the very short-run.

Fiscal stimulus measures that put upward pressure on future inflation of consumer goods amplify the impacts on aggregate demand due to the reduction of the real interest rate. This effect is also present in economies with autonomous monetary policy, if the lower limit of zero percent interest rate is reached (Eggertsson 2009, Christiano *et al*. 2009), or if monetary policy is fully accommodative (Freeman *et al.* 2009). However, on the other hand, if the policy measures put upward pressure on prices of tradable goods and ultimately on the price of exports, it will result in contractionary effects resulting from a fall in exports and an increase in the imported content of domestic production.

3.2. Temporary program: medium run effects

Although the usual method of measuring the effectiveness of fiscal policy is to focus on the impact multiplier, the macroeconomic effects are clearly not limited to this horizon. Beyond the fact that the temporary nature of the program implies a return of the policy instrument to its initial level, it will always be necessary to ensure the payment of the issued debt, which occurs in a gradual way in *PESSOA*.

Chart 3 presents the evolution of the labour income tax that ensures in the long run a return to the initial fiscal stance. As can be seen, all fiscal programs presented require an increase of this rate after the second year, after which the fiscal rule starts to be active, and a gradual reduction to the long-run stationary levels over the simulation horizon. The abrupt reduction of this rate in the first year occurs when the fiscal authority uses it as the instrument of the fiscal program.

Chart 4 presents the impacts in *PESSOA* for a relatively diverse set of macroeconomic variables over a time horizon of 10 years. These effects are associated with the return of the fiscal instrument to its initial level, as well as the activation of the fiscal rule. Assumptions (i) to (iii), which were in the origin of the results presented in Table 2, remain unchanged. The results illustrate from the outset that the macro-economic effects of fiscal programs entail a relatively intricate set of real and income flows between the different economic agents, until the stationary state is reached again. It is up to the fiscal authority, to take stock of the obtained results, to politically value them and, accordingly, take the decision that is more adequate to its goals. According to OECD (2009), countries implemented economic policies in 2009 that were based on instruments both on the expenditure and revenue sides.

Among the results, note first that, due to the temporary nature of the stimulus and the way it was designed, one should expect in all cases a reduction or households consumption and of GDP, between

Chart 3

| LABOUR INCOME TAX RATE | PERCENTAGE DEVIATIONS FROM THE INITIAL STEADY-STATE |
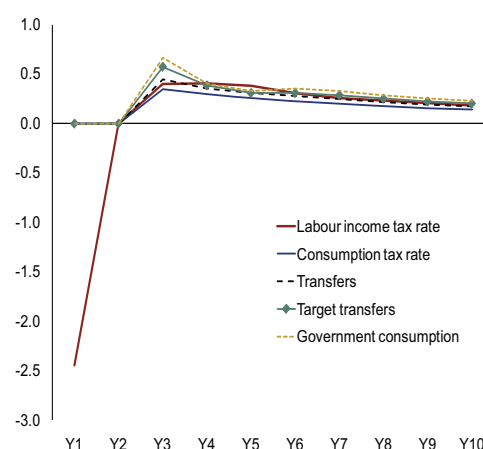
Source: Authors calculations.
Note: The periodicity is annual.

Chart 4

| IMPACTS OF FISCAL PROGRAMS | PERCENTAGE DEVIATIONS FROM THE INITIAL STEADY-STATE; INFLATION, IIP, FISCAL BALANCE AND PUBLIC DEBT DIFFERENCES IN PERCENTAGE POINTS |

Labour income tax —— Consumption tax —— General transfers - - - argeted transfers ▪ Gov. consumption - - -
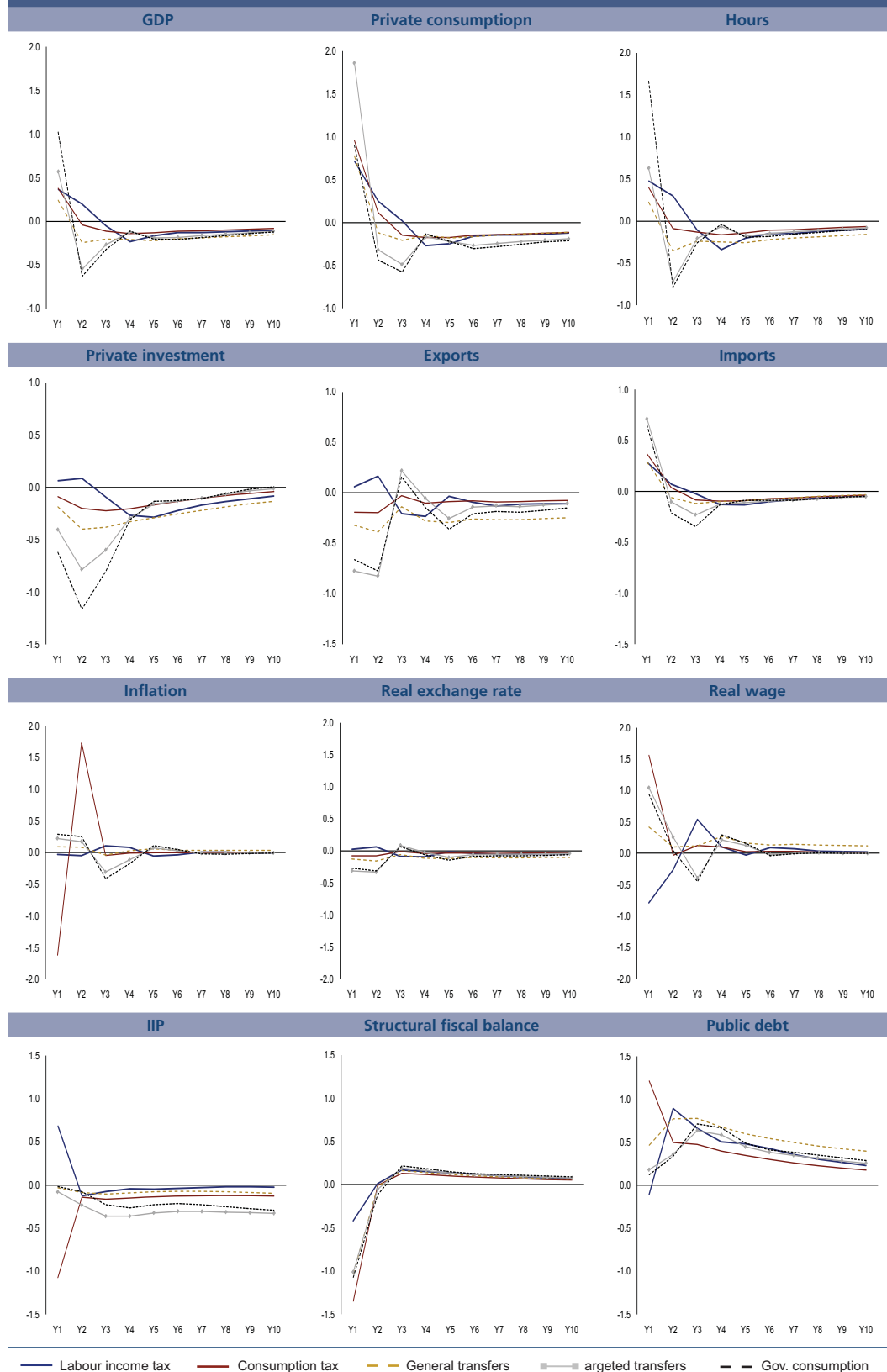
Source: Authors' calculations.

Notes: The periodicity is annual. The structural fiscal balance may differ from the effectively registered since it is computed with the tax bases at their stationary level. The real exchange rate is an indirect quotation and is calculated based on the prices of tradable goods. Inflation used to calculate the real wage is calculated based on prices of consumer goods paid by households

the first and second years. The decision to place the fiscal instrument back to its initial level implies a reduction in GDP that, in most cases, goes beyond the levels that characterized the initial state.

Secondly, debt consolidation will always involve an improvement of the fiscal balance relative to its steady state value. The Government structural fiscal balance assumes values higher than the initial steady state from the third year onwards, ensuring that public debt converges to the target, which is assumed to be exactly the same as the one prevailing before the program.

The comparative analysis of the different effects over time associated with the different fiscal instruments shows that the labour income tax should also be considered by the fiscal authority as a stimulus measure. While, on the one hand, it does not produce the higher impact multipliers on GDP or private consumption, it does not produce, on the other hand, a recessive effect similar to the one of the remaining options in the year in which the tax rate is repositioned at the initial level. Unlike other instruments, the second year remains a year in which GDP, household consumption, private investment and exports remain above the steady state (although at a lower level than in the first year). From the third year onwards, the effects associated with the different options are more similar.

The evolution of investment stems from a relatively complex set of interactions, where the foresight of the future plays a key role. The final result is determined inter alia by the temporary nature of fiscal measures, the evolution of the real interest rate and the relative price of investment goods. Thus, the temporary increase of the price of investment goods, in a context where agents anticipate the temporary nature of fiscal policy measures and where investment is subject to real rigidity, determines a reduction of spending on capital goods. With the exception of the use of labour income tax, all other options analised in Chart 4 imply in fact a further reduction of private investment in the second year of the program.

If the fiscal authority chooses to stimulate the economy with a temporary increase in government consumption, which has the highest impact multiplier on GDP (see Table 2), there will be an increase in demand for one type of goods with a high non-tradable content and very labour intensive. The increase in demand for these intermediate goods results in an increased demand for labor, which implies an increase in wages for all families. Despite the compression of profit margins, domestic prices increase and there is an appreciation of the real exchange rate, with negative impact on exports. Following the increase in income, households without access to the asset market react immediately and increase their consumption, while households with access to asset markets increase savings, but also the level of private consumption, as part of the increase in public debt is taken as an increase in wealth.

In line with the other expenditure components, imports show a decline to levels below the steady state after the year in which the stimulus is removed, gradually converging in the subsequent years to levels that prevailed before the stimulus. This evolution has a high positive correlation with the behavior of economic activity.

Among the most significant effects shown in Chart 4 is the one of inflation, in case the fiscal program is based on changes in the consumption tax rate. This fact is explained by the direct impact that the tax reduction has on consumer prices in the first year, followed by the decision to place the same rate back in the second year.

3.3. Permanent program: increase of public consumption

The temporary nature of the stimulus in all cases analyzed above implies a reduction of household consumption or GDP in the second year. This result, independent of the fiscal instrument that is used, can create an incentive to implement programs of a more permanent nature, which justifies the presentation in the different time horizons of an economic policy with these features.

This subsection presents an example of the impact of a fiscal measure with permanent nature: an increase in government consumption financed entirely by an increase in the labour income tax. It should be noted

Chart 5

LABOUR INCOME TAX RATE | PERCENTAGE DEVIATIONS FROM THE INITIAL STEADY-STATE
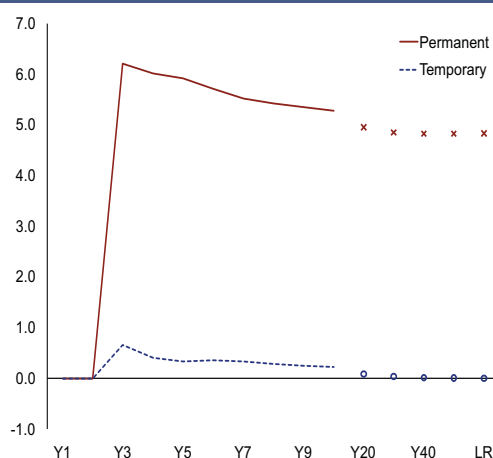
Source: Authors' calculations.

Notes: The chart presents annual values between years 1 and 40. The long-run is defined as "LR". The remaining definitions, as well as the interpretation of results were presented in chart 4.

however that the results are qualitatively very similar to any program of permanent increase in public spending financed by distortionary taxes, notwithstanding the fact that the impacts can be quantitatively different for some variables.

The evolution of the labour income tax rate associated with a permanent increase of public consumption is presented in Chart 5. As can be seen, a permanent increase of 1 percent of GDP ex ante implies an expressive and permanent increase of the tax rate in order to maintain unchanged the deficit and debt objectives. This evolution, which ensures the return to the initial fiscal stance, will have particularly negative effects on economic activity. Chart 6 shows the impact over several macroeconomic variables in different time horizons, including those that can be obtained in the very long run. These impacts are compared to those presented in Chart 4, where a temporary program was considered.

The impact multipliers over GDP or consumption remain positive, although lower than those of the temporary program. The reduction of these multipliers is explained by the anticipation of recessionary effects associated with the need to increase, in an equally permanent way, the labour income tax in the medium and long term. The need to finance a permanent increase in government consumption implies that all generations, present and future, will pay more taxes. In the case of households with access to the asset markets, these savings increase more than in the case where the program is temporary.

Unlike the case of temporary programs, the permanent increase of public consumption leads to a new steady-state in which the real increase of this variable does not compensate the permanent reduction in the other components of aggregate expenditure. GDP, in particular, presents a permanent fall. The dominant effect underlying this evolution results essentially from the increase in the tax rate in order to finance the fiscal program. Labour supply decreases, reflecting the strong disincentive to work stemming from the tax increase. This evolution contributes to reduce household consumption in a permanent way, relative to the initial steady-state, affecting households welfare in a significant way (Almeida *et al.*, 2010b).

The real wage paid by firms increases permanently to ensure the necessary labour supply, implying a permanent loss in competitiveness and a decrease in exports. The reduction of the capital stock desired by firms implies a downward adjustment of investment, which reaches a permanently lower level. The fall in exports, higher than the fall in imports, contributes to a deterioration in the long-run of the international investment position relative to the initial steady-state, which does not occur in the case of a temporary program.

Chart 6

A PERMANENT INCREASE OF GOVERNMENT CONSUMPTION | PERCENTAGE DEVIATIONS FROM THE INITIAL STEADY-STATE; INFLATION, IIP, FISCAL BALANCE AND PUBLIC DEBT DIFFERENCES IN PERCENTAGE POINTS
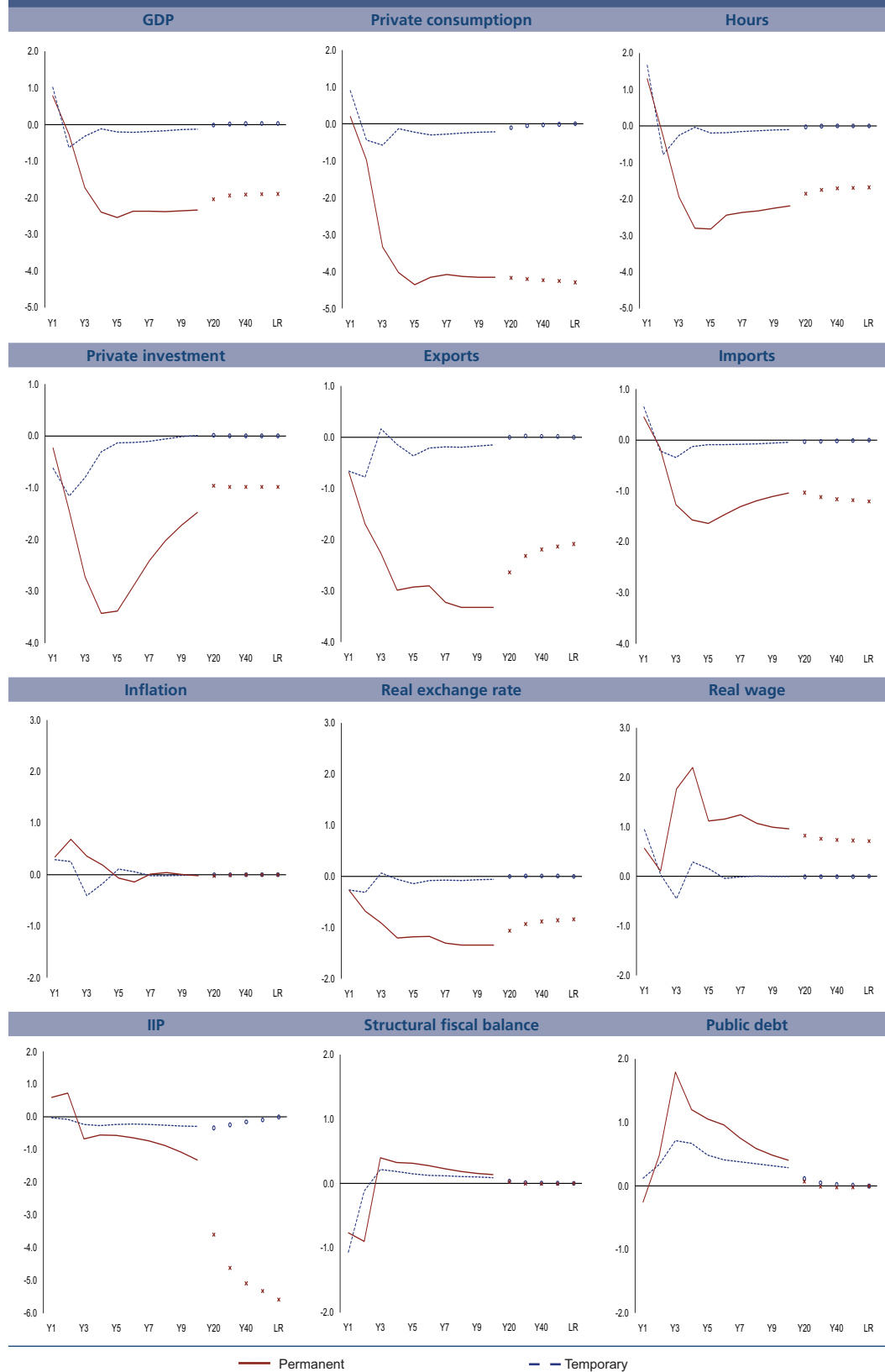
Source: Authors' calculations.

Note: The chart presents annual values between years 1 and 40. The long-run is defined as "LR". The remaining definitions, as well as the interpretation of results were presented in Chart 4.

As in temporary programs, there is a clear reduction path of public debt from the date when the fiscal policy rule is activated onwards. The maintenance of the fiscal goals that prevailed before the Government program is in this way ensured and only implies a recomposition of the Government balance presented in Table 1[5].

As mentioned above, it may further be noted that, in general, all fiscal programs involving both a permanent increase in expenditure and taxation in order to ensure the return to the initial fiscal policy stance, tend to produce undesirable medium and long-term effects in *PESSOA*, which are mainly due to the distortionary effects of these taxes.

4. Alternative exit strategies

The transmission mechanism of fiscal policy is conditioned by the exit strategy that agents expect that the authorities will have. It is assumed, in all cases that the exit strategy is perceived equally by all agents, who incorporate it in their decision making process. This strategy may be more or less rapid in bringing the fiscal stance back to its initial stance.

This section considers two alternative exit strategies identified as "Fast" and "Slow", which differ in the time gap that agents envision that the authorities consider desirable to return to the initial fiscal stance[6]. The results obtained with each alternative exit strategy are compared to those previously presented ("Reference" exit strategy).

Section 4.1 presents the macroeconomic impact of alternative exit strategies, in a context of maintenance of the risk premium on sovereign debt. Section 4.2 considers the possibility that these strategies can take place in a context where there is an increase in the risk premium, correlated with the deviation of public debt from the objective set by the fiscal authorities.

The simulations presented are based on the assumption that fiscal authorities announce exit strategies perceived by agents as credible. This assumption implies in particular that agents perceive the consolidation measures as being implementable within the announced timeframe. In this context, exit strategies whose trajectory involves extremely strong consolidation measures may not be taken as credible by agents.

In the simulations, government consumption is considered as the fiscal instrument used for business cycle stabilization and the fiscal rule is, as before, activated two years after the start of the program (t_2 in Chart 2).

4.1. Without change in the risk premium

Chart 7 shows the evolution of the labour income tax rate required for the fiscal balance and the public debt return to the levels pre-defined by the Government, which prevailed before the fiscal program. No change in the economy's risk premium is considered in any of the simulation exercises. As can be seen, the tax rate increases in a more significant way in the case of the Fast strategy and in a less visible way in the case of the Slow strategy.

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5 It is possible to find other possibilities in the literature. Röeger and Veld (2010), for example, evaluate the impact of a permanent deterioration of 1 per cent of the fiscal balance, which, according to the assumptions on long-run growth of nominal GDP implies in the DSGE model an increase in the ratio of public debt to GDP of 20 p.p. This deterioration of the fiscal balance would imply in *PESSOA* an increase in public debt of approximately 25 p.p., relative to the *ex ante* steady-state GDP.

6 Technically, the simulations implied an adjustment of parameter d_2 of the fiscal rule presented in Section 2 of this article. In the case of the Slow strategy, the parameter was reduced to practically zero; in the case of the Fast strategy, it was increased to around four times of the Reference strategy. Almeida *et al.,* (2010b) presents a set of simulations that differ in the instrument used in the fiscal rule.

Chart 7

— Slow   ▬ Reference   – – Fast
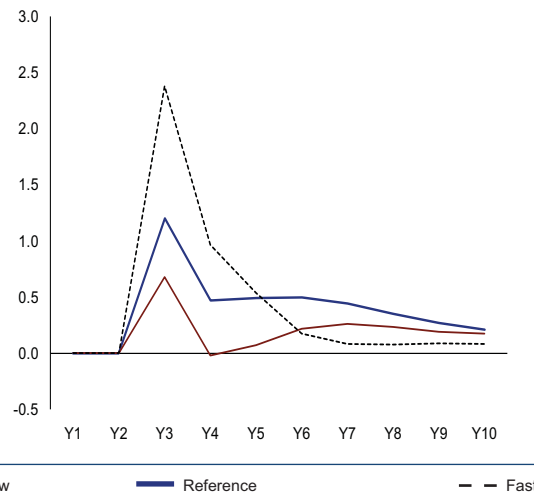
Source: Authors' calculations.

The macroeconomic impacts of the alternative exit strategies are presented in Chart 8. Firstly, it can be seen that the impact multipliers are almost the same. Thus, maximizing the impact on GDP in the first year depends only to a minor extent on the different exit strategies. The similarities are not limited to the first year, existing until the moment when the fiscal rule is effectively activated. After the first two years, the results begin to diverge significantly, which is an element that should be valued by the fiscal authorities in the selection of the speed of the fiscal consolidation process.

The Reference simulation represents an intermediate option when compared to the Fast and Slow strategies. The increase in the tax rate is so significant in the case of the Fast strategy that the public debt goes immediately to values close to the long-run target, producing a recessive effect on economic activity.

In the case of the Slow strategy, the increase in the tax rate is so smooth that the public debt reduces only gradually after the rule is activated. Due to the high inertia, the public debt remains well above its long-run value even after ten years. This result occurs in parallel with a faster return of the economy to values close to the stationary state, with GDP being almost at its steady-state value from the fourth year onwards.

In the absence of any movement in the economy's risk premium, results in Chart 8 indicate that there are several factors that favor the option of a Slow strategy, in which the fiscal consolidation process is very gradual. These results are in line with a large literature that suggests that the optimal fiscal policy corresponds to tax smoothing (Chari and Kehoe 1999, Chari *et al.* 1994). Besides not reducing the short-term effect on GDP or consumption, and not having the undesirable effects associated with a permanent increase of public consumption, this exit strategy is visibly less recessive in the medium-run than the Fast or Reference strategies. This conclusion, while justifying the creation of public debt that is consolidated only very gradually with tax increases is not, however, robust to a context in which the risk premium does not remain unchanged.

4.2. With change in the risk premium

The increase in the sovereign debt risk premium registered in the most recent period suggests the possibility of a relationship between risk premiums and the indebtedness level of the economies. This subsection analyses the three strategies considered (Slow, Fast and Reference) in a context where the risk premium is associated with the level of public debt, in contrast to the previous simulations where it was assumed to be constant.

Chart 8

ALTERNATIVE EXIT STRATEGIES (WITHOUT INCREASE OF THE RISK PREMIUM)
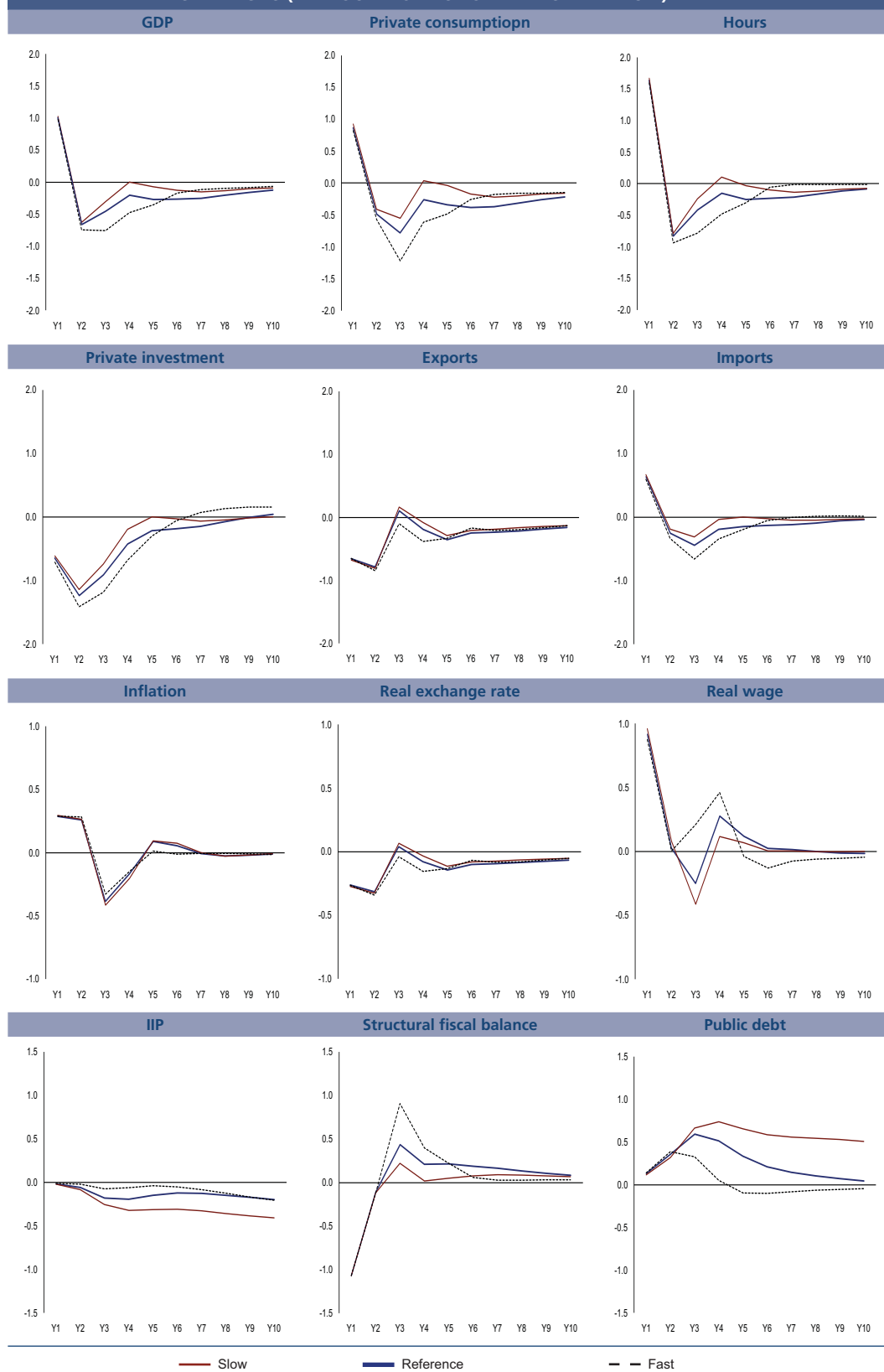
Source: Authors' calculations.

Note: The interpretation of results were presented in Chart 4.

In this context, it was considered an increase in the risk premium of 6 basis points for each percentage point of increase in the public debt. This value was calibrated based on the existing literature, particularly in studies for the United States, which point to increases of the interest rate between 1 and 6 basis points for each percentage point of increase in public debt (Laubach 2003, Engen and Hubbard 2004, and Gale and Orszag 2004).

Charts 9 and 10 show the evolution of the labour income tax rate as well as the economy's risk premium. Until the activation of the fiscal rule, the tax rate remains unchanged in the three strategies considered (Slow, Fast and Reference). Thereafter, the tax rate increases sharply and in a more expressive way than before, i.e. in the case in which the various alternative exit strategies does not imply any impact on the risk premium.

The increase in interest rates in the small open economy creates a positive differential in relation to the interest rate that prevails in the euro area and implies an increase in interest outlays for the same level of public debt stock. The higher the interest rate the greater the increase in public debt during the period in which the fiscal policy rule is disabled. To return to the initial fiscal stance, it is now necessary to reduce the public debt from higher levels than in the case where there was no impact on the risk premium.

The macroeconomic impacts of the Fast, Reference and Slow exit strategies in the case in which the small open economy agents see an increase in the risk premium due to the increase in the public debt are presented in Chart 11. As can be seen, the impact multipliers are slightly lower than the ones previously reported, particularly in the case of the Slow strategy. The short-term multiplier of private consumption is even negative in the first year, reflecting to a large extent the more expressive increase of the domestic real interest rate. Additionally, the medium-run effects also seem to discourage the implementation of the Slow strategy. Both GDP and households consumption present in this case a higher period of time below the levels associated with the stationary state. On the contrary, the promotion of a Fast strategy is the one that puts the economy in the medium run more rapidly in the stationary state. However, it is crucial that the substantial fiscal policy measures necessary for this strategy are possible.

Chart 9

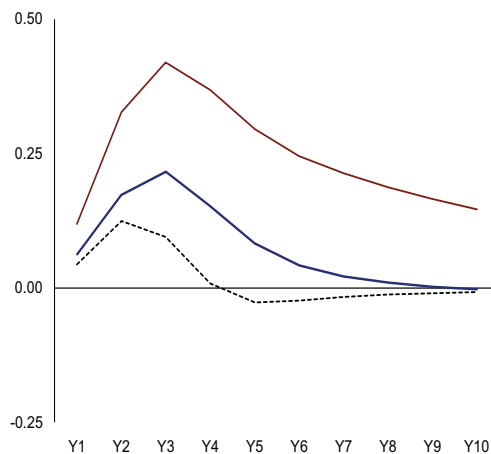LABOUR INCOME TAX RATE (WITH INCREASE OF THE RISK PREMIUM) | PERCENTAGE DEVIATIONS FROM THE INITIAL STEADY-STATE
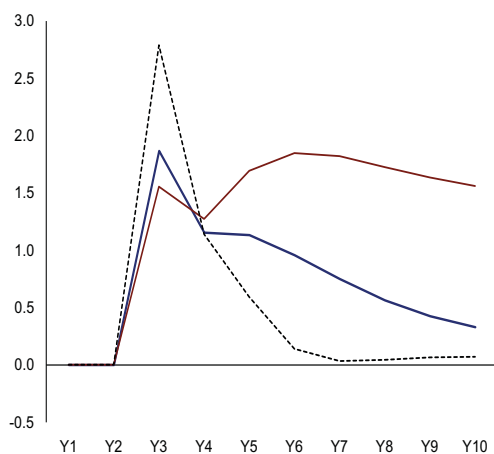
Chart 10

RISK PREMIUM | PERCENTAGE DEVIATIONS FROM THE INITIAL STEADY-STATE

Source: Authors' calculations.

Slow — Reference — Fast

Source: Authors' calculations.

Chart 11

ALTERNATIVE EXIT STRATEGIES (WITH INCREASE OF THE RISK PREMIUM) | PERCENTAGE DEVIATIONS FROM THE
INITIAL STEADY-STATE; INFLATION, IIP, FISCAL BALANCE AND PUBLIC DEBT DIFFERENCES IN PERCENTAGE POINTS
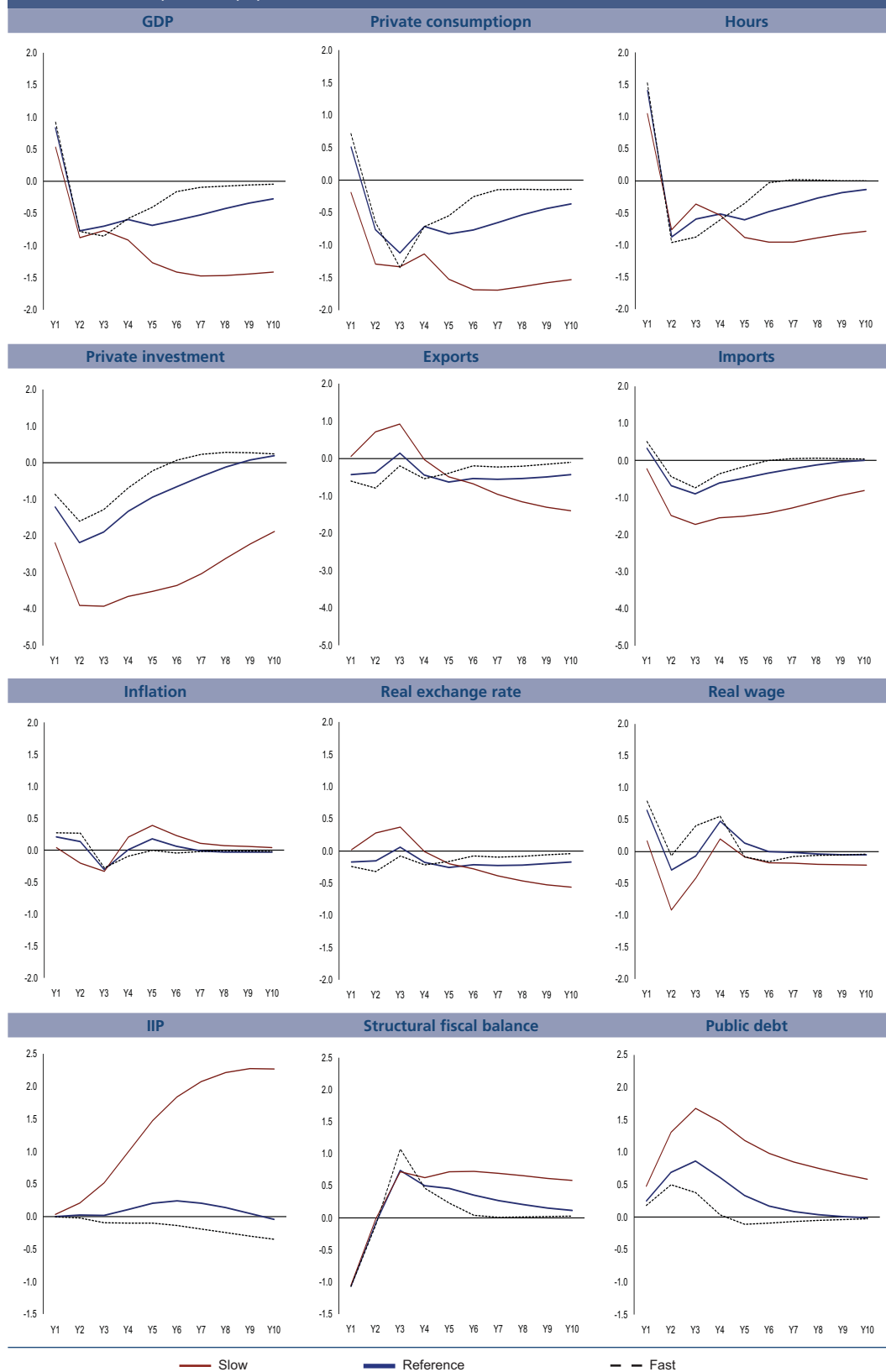
Source: Authors' calculations.

Notes: The interpretation of results were presented in Chart 4.

5. Conclusion

This article discusses the role of fiscal policy for macroeconomic stabilization in a small open economy of the euro area. The analysis was conducted in a general equilibrium context in order to capture the transmission mechanisms that cannot be analysed in partial equilibrium contexts. The results suggest that fiscal policy can play an active role in stabilizing the business cycle, affecting several variables of interest, in particular GDP and households consumption. Fiscal programs should not however focus exclusively on the short-run effects and ignore the medium run impacts of the fiscal consolidation strategies, i.e., of the need to adequate public revenues and spendings after the end of the program such that the fiscal policy stance returns to its initial position.

The diversity of effects obtained showed that macroeconomic stabilization is clearly a multidimensional problem. It will always be up to the fiscal authority to set priorities and decide according to the objectives it desires to achieve. According to the results, if the objective is to stimulate economic activity, the most effective way of achieving it is by a temporary increase of public consumption. If the objective is to increase households consumption, the best way to achieve it is by an increase in transfers to households without access to asset markets, whose marginal propensity to consume is higher. The results further substantiate the perspective that a permanent increase in government consumption generates undesirable effects over time, particularly due to the financing needs implied by that decision.

The results obtained in this article are far from those suggested by the traditional Keynesian multipliers, which are typically obtained in a context of partial equilibrium and, in the most extreme cases, do not translate the impacts on supply conditions and its interaction with the sources of fiscal policy financing. Additionally, there are recessionary effects associated with the reversal of a fiscal stimulus that cannot be neglected and that stem from the need to consolidate after the stimulus programs, i.e., to return to the initial fiscal policy stance.

Finally, the effectiveness of stabilisation programs is not independent of the economy's risk premium attributed by agents participating in asset markets. If it is reasonable to assume that this premium remains constant, results tend to favour a slower and more gradual exit strategy. If the stimulus program entails an increase of the risk premium, due to the level of public debt, the results favour a faster exit strategy, since otherwise it can end up in a situation more undesirable and long-lasting than the initial one. However, it is crucial that the fiscal measures necessary to implement such a strategy are perceived as feasible.

The role of fiscal policy presented in this article is conditioned by the assumptions and calibration of *PESSOA* (Almeida *et al.,* 2010C). It is not considered, for example, policy options that involve structural changes in the economy or generate externalities, such as an improvement of the justice system or of education. The effects of these measures are beyond this article. The effects that may arise from fiscal policies more focused in the long-run are not evaluated as well, for example associated with a reduction of the predefined goals for public debt by the authorities, nor the impact of fiscal policy on income distribution.

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PRODUCTIVITY, SIZE AND CAPITAL INTENSITY IN SELECTED PORTUGUESE MANUFACTURING SECTORS: A NON-PARAMETRIC ANALYSIS*

*João Amador***

This article adopts a non-parametric approach to explore the relation between size, capital intensity and productivity in a set of Portuguese manufacturing sectors. The article makes use of 2007 data from firm's balance sheets and income statements in sectors "food and beverages", "clothing", "manufactured non-metallic mineral products" and "metallic products, except machinery and equipment". In 2007, these four sectors represented almost half of the total number of manufacturing firms, more than one third of gross value added and sales and more than forty per cent of employment and capital stock in the Portuguese manufacturing sector. Firstly, the article presents basic descriptive statistics regarding the distribution of firms along the selected variables. Secondly, the analysis is enlarged by estimating robust conditional kernel distributions for the pairs of variables *capital intensity-productivity, size-productivity* and *size-capital intensity*. The unconditional distributions for the selected variables reveal some similarities between sectors. There is substantial heterogeneity within sectors but firms are concentrated in classes that correspond to small size, low capital-labour ratios and small number of workers. The conditional distributions reveal that the largest firms in terms of sales tend to be those with higher capital-labour ratios and these two characteristics tend to lead to higher levels of apparent labour productivity.

1. Introduction

Capital intensity, size, and productivity of firms are three key variables in empirical and theoretical industrial organization (IO) literature. The capital intensity, defined as capital stock over total employment, is an important component in the characterization of the production process as it reflects the combination of inputs in the production function. Nevertheless, empirical literature has not devoted much attention to this variable because data refering to sectoral capital stocks is typically non-available and existing aggregate data is plagued with statistical problems.[1] The recent availability of large longitudinal firm-level data sets, namely drawing on firms' balance sheets and income statements, has provided additional information on the capital stock. In this context, capital is defined as fixed plus intangible assets, as accounted in the balance sheet. Accounting methods and procedures affect this measure, though it is typically more robust than usual aggregate indicators. A limited number of articles focus on the impact of the capital stock on gross value added (GVA) or productivity. These articles usually estimate production functions or perform sectoral growth accounting exercises. In addition, some papers focus on the impact of financial

1 Estimates of the aggregate capital stock typically rely on the perpetual inventory method. This method arrives at the level of capital stock by accumulating flows of gross fixed capital formation and assuming a constant depreciation rate. Assumptions on this latter rate and on the initial level of capital stock necessarily affect the path of the capital series.

markets or financing conditions on capital intensity (see, for example, Spalliara (2009)), while others relate capital intensity and wages (Arai (2003) and Leonardi (2007)).

Size is a classical variable in IO literature, usually defined as the total number of workers in the firm or total sales. This variable also links with the characteristics of the production process, namely in terms of returns to scale, either internal or external to the firm. As regards size, the literature mostly focuses on the evolution of the firm size distribution (see, for example, Cabral and Mata (2003) and Angelini and Generale (2008)) and on their determinants (Kumar *et al.* (1999) and Mata and Machado (1996)).

Productivity is usually measured as GVA per worker and it is interpreted as an outcome of the production process, affecting overall competitiveness. This ratio is sometimes defined as *apparent labour productivity* to distinguish from *total factor productivity*, which is obtained from a growth accounting exercise where capital and labour are explicitly considered as factors of production. The literature has also studied productivity issues, analyzing both the link between firm dynamics and productivity growth (see, for example, Bartelsman and Doms (2000) and Ahn (2001)) and the relation between productivity and size (Leung *et al.* (2008)).

This article takes data from balance sheets and income statements of Portuguese manufacturing firms in 2007 and adopts a non-parametric approach to relate size, capital-intensity and productivity. The paper presents some descriptive statistics and estimates conditional kernel distributions for the pairs of variables *capital intensity-productivity, size-productivity* and *size-capital intensity*. This analysis complements existing studies and it is relevant in terms of policy, especially in a context where Portuguese firms show comparatively low average productivity levels in international terms. For example, Cabral (2007) offers an in-depth analysis of Portuguese firms comprising entry and exit decisions, firm size, productivity and distortions to economic activity.

The non-parametric approach adopted in this article is basically descriptive and does not capture causal relations. Nevertheless, it has some advantages. Firstly, it imposes no prior structure on data. Secondly, it is robust to different distributions for the original data. The approach of this article is close to that of Huynh e Jacho-Chavez (2007), though this latter paper is mostly methodological, illustrating the estimation of conditional kernel densities.

The article analyses four manufacturing sectors: ``food and beverages'', ``clothing'', ``manufactured non-metallic mineral products'' and ``metallic products, except machinery and equipment''. In 2007, these four sectors represented almost half of the total number of manufacturing firms, more than one third of GVA and sales and more than forty per cent of employment and capital stock in the Portuguese manufacturing sector. Aggregate technological classifications typically consider the first two sectors as low-tech and the last two as medium low-tech.[2] Medium high-tech and high-tech categories represent about one third of total Portuguese GVA and about one fifth of total firms. In fact, the number of firms in the sectors that compose such technological categories is relatively low.[3] This fact limits the use of those sectors in the article, notably in the estimation of the robust kernel conditional densities.

The article is organized as follows. In the next section we present the database. In section 3 we present some descriptive statistics based on sectoral firm data and the results for the estimated conditional kernel distributions. Section 4 presents some concluding remarks.

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2 The classification used is according to Loschky (2010) and it is very close to the OECD taxonomy based on manufacturing industries' technological intensity (see OCDE(2009)).

3 In our data, the shares of low-tech, medium low-tech, medium high-tech and high-tech in GVA are 42.6, 28.8, 25.3 and 3.3 per cent, respectively. The shares of firms in these categories are 51.9, 26.3, 19.8 and 2.0 per cent, respectively.

2. Database

The data used in this article draws on information about the annual accounts of corporations reported under the *Informação Empresarial Simplificada* (Simplified Corporate Information, Portuguese acronym: IES). The IES exists since 2006 and it covers virtually the universe of Portuguese non-financial corporations. The almost universal coverage of the IES emerges from its nature, as it is the system through which corporations report mandatory information to the tax administration and the statistical authorities. Under the IES, firms provide information about the balance sheet and the income account, as well as additional information on the number of employees, their categories and costs, and total exports and imports.

As it was previously said, the article considers sectors ``food and beverages'' (CAE 15), ``clothing'' (CAE 18), ``manufactured non-metallic mineral products'' (CAE 26) and ``metallic products, except machinery and equipment'' (CAE 28).[4] Table 1 reports the shares of the different sectors in terms of GVA, number workers, capital stock and sales and the total number of firms in the sample in 2007.[5] The four selected sectors represented 47.4 per cent of manufacturing firms, 37.2 per cent of GVA in the manufacturing sector, 34.6 per cent of sales, 44.5 per cent of employment and 42.8 per cent of capital stock. Therefore, the four sectors considered represent a significant share of the Portuguese manufacturing sector. The firms with zero workers, zero capital or with negative GVA were removed from the sample. Therefore, numbers presented do not necessarily coincide to IES aggregates.

Table 1

SHARE OF SECTORES AND NUMBER OF FIRMS IN MANUFACTURING (2007)						
Sector	CAE 2.1	Shares				Number of firms
		GVA	Workers	Capital stock	Sales	
Food products and beverages	15	13.5	13.3	22.1	16.6	4615
Tobacco	16	1.1	0.1	0.5	0.6	3
Textiles	17	5.5	8.8	6.3	4.7	2295
Clothing	18	5.5	13.4	2.5	3.9	4038
Leather and footwear	19	3.1	6.1	1.5	2.6	1598
Wood and products of wood and cork, excep furniture	20	4.4	5.0	4.4	4.8	2649
Pulp, paper, paper products	21	4.5	1.6	7.6	3.5	348
Printing and publishing	22	4.9	4.2	4.1	3.1	2612
Coke, refined petroleum products and nuclear fuel	23	3.4	0.3	3.9	9.0	7
Chemicals and chemical products	24	5.7	2.7	6.0	5.8	630
Rubber and plastics products	25	4.3	3.3	3.5	3.8	813
Other non-metallic mineral products	26	9.2	7.4	11.5	6.9	2420
Basic metals	27	2.2	1.4	1.9	3.6	243
Fabricated metal products except machinery and equipment	28	9.0	10.4	6.6	7.3	5487
Machinery and equipment n.e.c	29	6.1	5.5	4.0	4.7	2174
Office, accounting and computing machinery	30	0.1	0.1	0.0	0.2	29
Electrical machinery and apparatus n.e.c	31	3.1	2.6	1.6	3.6	495
Radio, television and communication equipment	32	2.3	1.3	1.7	2.3	129
Medical, precision and optical instruments	33	0.8	0.8	0.4	0.6	524
Motor vehicles, trailers and semi-trailers	34	5.1	3.6	4.9	7.3	350
Other transport equipment	35	1.5	1.6	1.0	1.1	267
Furniture	36	3.7	6.1	3.1	3.2	3005
Manufacturing n.e.c; recycling	37	0.6	0.4	0.7	0.9	233
Sum		**100**	**100**	**100**	**100**	**34964**
Share of selected industries (CAE 15+18+26+28)		**37.2**	**44.5**	**42.8**	**34.6**	**47.4**

Source: Author's calculations based on a sample from IES.

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4 CAE is the acronym for ``*Classificação das actividades económicas*'', the Portuguese classification of economic activities.

5 As a robustness test, all calculations presented in the article were repeated using 2008 data and the results are unaltered.

3. Productivity, size and capital intensity

As previously mentioned, the article focuses on the relations between three key variables: size (measured as total sales in euros), capital intensity (fixed plus intangible assets over total employment) and productivity (ratio between GVA and total employment). In conceptual terms, capital intensity and size of firms are important determinants of firms' productivity. In addition, the relation between size and capital intensity tells us whether larger firms are more capital intensive or if small firms are able to adopt such technologies. Nevertheless, as previously mentioned, the approach followed in this article is mostly descriptive, thus not establishing causal relations between the variables.

3.1. Unconditional distributions

One of the important results that has emerged from the empirical studies based on firm-level data is that there is a great deal of heterogeneity between firms, even within sectors, i.e., in a given sector firms with very different sizes, productivity levels and capital-labor ratios coexist. Part of this heterogeneity is associated with different types of goods produced. In fact, taking a two-digit CAE sector, there is still substantial diversity in terms of products and technologies within each cathegory. Nevertheless, even at more detailed levels of the classification, heterogeneity subsists.

Charts 1 and 2 present the relative densities of productivity, capital intensity, employment and sales across the four selected sectors. We begin by comparing the four sectors in terms of the shape of the relative distribution for the different variables and then comment separately on the characteristics of each sector. For comparative purposes, annex 1 presents some basic moments for the distributions of the selected variables across all Portuguese manufacturing sectors in the sample that is used.

Charts 1 and 2 show that the relative frequencies of productivity (GVA per worker) in low-tech sectors ``food and beverages'' and, especially, ``clothing'' are significantly right-skewed, while medium-low-tech sectors ``manufactured non-metallic mineral products'' and ``metallic products, except machinery and equipment'' present distributions that are closer to the Gaussian shape. The differences between these distributions reflect a better performance in the medium-low-tech sectors but there are also firms in ``food and beverages'' and ``clothing'' that are very productive, probably operating with high-technologies. In addition, ``clothing'' stands out with a very high relative frequency in low capital-labour ratios, in a scenario where all the four sectors present distributions that are highly skewed to the right. This means that most Portuguese manufacturing firms in these four sectors use low capital-intensive technologies. This is compatible with previous aggregate studies where Portugal is identified as having low capital-labour ratios, when compared with other industrialized economies (see Amador and Coimbra (2007)). In a context where world technological progress is stronger in capital intensive sectors and technologies, this underlying situation is an important handicap in terms of productivity gains and GDP growth.[6] The distributions of sales and workers in the four sectors considered are also skewed to the right. Finally, sector ``metallic products except machinery and equipment'' shows a lighter right tail, meaning that relatively less firms present high employment levels.

As for the sector ``food products and beverages'', the capital-labour ratio is high in comparative terms, especially in a sector that is usually classified as low-tech. In addition, this sector shows a high relative frequency of firms with low levels of sales. Nevertheless, the median and mean productivity are slightly lower than in the whole set of manufacturing firms. On aggregate terms, the report "*Key figures in European business*"(Eurostat (2010)), which offers an overview of business activities in the EU-27, refers

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6 It should be noted that investment rates were relatively high in the Portuguese economy, especially in the second half of the nineties. Nevertheless, it has been acknowledged that the starting levels of the capital stock were very low and much of this investment was directed towards non-tradable sectors, limiting the evolution of the overall competitiveness of manufacturing firms.

Chart 1

DESCRIPTIVES: FOOD AND BEVERAGES (CAE 15) AND CLOTHING (CAE 18)
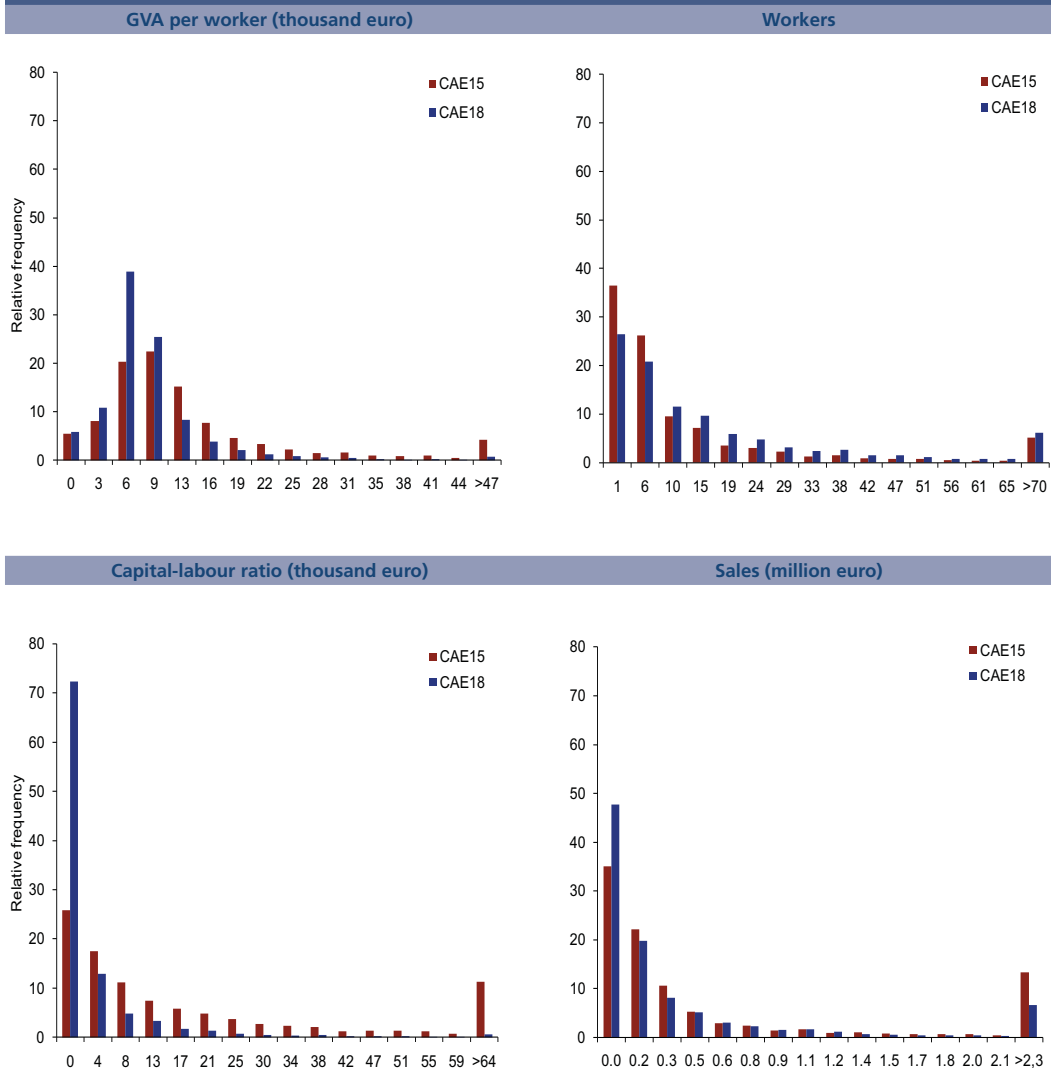
Source: Author's calculations based on a sample from IES.

Note: Each frequency interval includes the observations with values larger than the one referred and lower or equal than what is referred for the next interval.

in that in 2007 this sector presented an apparent labour productivity that was close to that of the manufacturing sector. A similar result is obtained for Portugal, though the productivity level in ``food products and beverages'' in the EU-27 was almost 80 per cent higher than that observed in Portugal. Finally, it is relevant to remark that this is a very heterogeneous sector in terms of products, ranging from meat and fish products to dairy products, bread and beverages. Comparing with other EU-27 countries, Portugal presents a significant specialization in the processing and preserving of fish and fish products.[7]

When the ``clothing'' sector is analysed, we observe that the mean and the median of the distribution of the capital-labour ratio is the lowest of all manufacturing sectors (see annex 1). In addition, ``clothing'' is one of the sectors with the lowest mean for sales and productivity. Nevertheless, there are higher relative frequencies for larger numbers of workers, i.e., there are relatively more firms with many employees, when compared with the other three sectors studied. These features are consistent with the analysis

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7 Specialization is here assessed by the share of the sub-sector in the non-financial business sectors' GVA.

Chart 2

DESCRIPTIVES: NON-METALLIC MINERAL PRODUCTS (CAE 26) AND METALLIC PRODUCTS, EXCEPT MACHINERY AND EQUIPMENT (CAE 28)
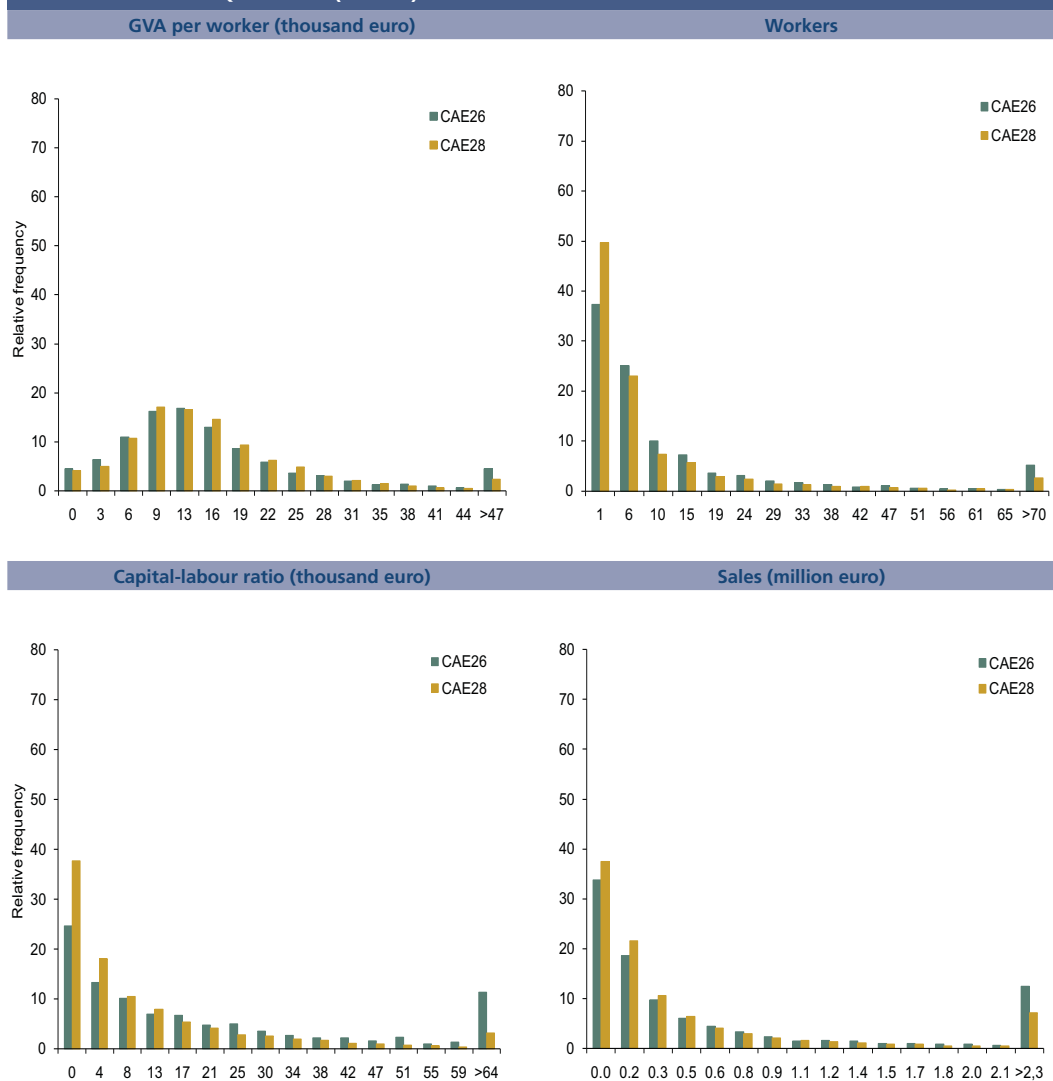
Source: Author's calculations based on a sample from IES.

Note: Each frequency interval includes the observations with values larger than the one referred and lower or equal than what is referred for the next interval.

made in Amador and Opromolla (2009), which focus on the Portuguese textile and clothing sectors. In particular, it is said that the structure of the Portuguese textiles and clothing sectors is based on small-medium firms and the analysis of firm-level data reveals some reduction in their average dimension from 1996 to 2005. This reduction is visible along several dimensions, namely sales. This was partly due to increased competition from new players in international trade, notably China.

The sector of ``other non-metallic mineral products'' is also quite heterogeneous, including glass manu-facturing, the manufacture of ceramic and clay products, the manufacture of cement and concrete and the working of stone and miscellaneous non-metallic mineral products. This sector presents a relatively high capital-labour ratio, when compared with other manufacturing sectors. In addition, it shows slightly higher relative frequencies for higher levels of productivity and sales, when compared with the other three sectors considered. Furthermore, it is worth mentioning that there is a noticeable geographical concentration of these firms in Portugal. The Centro region stands as a regional cluster with relatively

high employment in this sector. According to Eurostat (2009), in 2006 this was one of only three regions across the EU-27, behind the Province of Namur (Belgium) and Swietokrzyskie (Poland), in which just over 5 per cent of the non-financial business economy workforce was engaged in the manufacturing of non-metallic mineral products.

Finally, sector of ``fabricated metal products except machinery and equipment'' shows a smaller median and, mostly, a smaller mean in terms of workers and capital-labour ratio, when compared with the overall set of manufacturing firms. Average productivity levels are close to the average of the manufacturing sector. Nevertheless, in aggregate terms, in 2006 this sector presented in Portugal productivity levels that were less than half of those recorded in the average of the EU-27 countries.

Overall, it is possible to identify some important differences across sectors, though Portuguese firms tend to be small in terms of sales and number of workers and with low levels of capital per worker. These features partly explain comparatively low firm-level and aggregate productivity in international terms. Nevertheless, the previous analysis neither informs on the distribution of productivity levels along the capital intensity or sales dimensions, nor on the relation between capital intensity and firm size. The next section moves in this direction by computing a set of conditional distributions in the four selected sectors.

3.2. Conditional distributions

In this section the nonparametric methods suggested by Hyndman *et al.* (1996) are used to analyze the conditional distributions across the pairs of variables *capital intensity-productivity, size-productivity* and *size-capital intensity*. The nonparametric methods allow for the analysis of different features of the data, without making *a priori* assumptions about the underlying causal relationships.[8] The choice of the optimal bandwidths to be used in the estimation of the conditional density is an important component of the estimation procedure, especially when the data does not come from gaussian or uniform distributions. The bandwidth selection method used in this article is the *maximum likelihood cross-validation* and the bandwidth type is *fixed*, as discussed in Hall *et al.* (2004). The np package, by Hayfield e Racine (2008), which runs in the R statistical environment, is used to compute the optimal (data dependent) bandwidth for each conditional density estimation. The continuous kernel type chosen by the package in the different sectors was a second-order Gaussian distribution. These parameters are plugged in the hdrcde package, by Hyndman e Einbeck (2009), in order to estimate and plot the conditional densities and the corresponding highest density regions (HDRs).

Charts 3, 4 and 5 report the estimated robust Kernel conditional distributions for the selected sectors. All variables are taken in natural logarithms. The left-hand side panels present the conditional distributions for the four sectors considered, while the right-hand side panels present the highest density regions (HDRs). The latter plots are computed from the conditional density estimates and show the smallest interval in the sample containing a given probability. This representation provides a clear two-dimensional picture of the information contained in the conditional distributions. The darker-shaded region corresponds to a 50% HDR and the lighter tone delimits the 95% HDR. The mode of each conditional density is shown as a bullet (•).

Chart 3 plots the conditional distributions for productivity relatively to different levels of capital intensity (capital-labour ratio). The figure shows that the conditional distribution of firm's productivity moves to slightly higher values when the conditioning capital-labour ratio increases, i.e., there is a higher probability of finding firms with higher productivity levels among those with higher capital intensity. This relation is stronger for high conditioning levels of capital intensity, especially in sector ``manufactured

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8   See, for example, Huynh e Jacho-Chavez (2007) for an application of estimated kernel conditional densities to manufacturing firm-level data from Ecuador and Amador *et al.* (2010) for an application to international trade in Portugal, Spain Greece and Ireland.

non-metallic mineral products". In addition, the conditional distributions are concentrated in relatively narrow intervals, i.e., the amplitude of the HDRs is small. This means that firms within each interval of capital intensity do not show large variability in terms of productivity levels. Nevertheless, the amplitude of the HDRs somewhat increases in high conditioning levels of capital intensity in sector ``manufactured non-metallic mineral products''.

As for the conditional distributions of productivity relatively to sales in the four selected sectors, chart 4 shows that there is an increase over higher conditioning values of sales. This positive relation is stronger than the one observed with the conditional distributions on capital-labour ratios in chart 3. However, conversely to the previous set of conditional distributions, the amplitudes of the HDRs are larger for lower values of the conditioning values of sales, i.e., there is a higher dispersion of productivity levels among those firms with lower levels of sales. This pattern is particularly strong in case of ``food and beverages'', where some small firms are more productive than very large ones.

Finally, chart 5 presents the conditional distributions of capital-labour ratios along different firm sizes (sales). Firstly, it is possible to identify a positive relation between the conditioning values of sales and the interval of values where the corresponding distribution of capital-labour ratios is placed, i.e., the probability of finding firms with higher capital intensities increases among those of larger size. Secondly, the conditional distributions are dispersed along relatively broad intervals, i.e., the amplitude of the HDRs is large, though clearly decreasing for the largest firms. Therefore, firms with different sizes can present relatively close capital-labour ratios, especially those of medium dimension. Such broad intervals could be explained by the coexistence of firms in different stages of their life-cycle, i.e., different capital vintages. Nevertheless, there are some differences across the four sectors considered. The amplitude of the HDRs is comparatively small for low values of sales in sector ``food and beverages'' but increases significantly for medium-size firms. In addition, in the sector ``manufactured non-metallic mineral products'' the mode of the conditional distributions strongly increases with firm size, while in the sector ``metallic products, except machinery and equipment'' this evolution is the lowest of the four sectors.

Overall, taking the set of four manufacturing sectors under analysis, there is a somewhat higher probability of finding high productivity firms in classes with higher capital-labour intensity and a clearly higher probability amongst those with larger sales. As for sales and capital intensity, there is also a positive relation as more capital intensive firms are found within classes of larger sales. Therefore, the largest firms in terms of sales tend to be those with higher capital-labour technological combinations and these two characteristics tend to lead to higher levels of apparent labour productivity.

4. Concluding remarks

This article selects four representative Portuguese manufacturing sectors - ``food and beverages''; ``clothing''; ``manufactured non-metallic mineral products'' and ``metallic products, except machinery and equipment'' - and performs a non-parametric analysis using 2007 firm-level data. These sectors are a significant part of the Portuguese manufacturing sector, whose aggregate productivity level is much lower than that observed in the average of the EU-27 countries. The article focuses on the relation between size (sales), capital intensity (capital-labour ratio) and productivity (gross value added per worker) in the selected sectors.

The unconditional distributions for the selected variables reveal some similarities between sectors. Firstly, there is substantial heterogeneity within sectors but firms are concentrated in classes that correspond to small size, low capital-labour ratios and small number of workers. This pattern is particularly strong in sector ``clothing''. Secondly, the analysis shows that the relative frequencies of productivity in low-tech sectors ``food and beverages'' and, especially, ``clothing'' are significantly right-skewed, while medium-low tech sectors ``manufactured non-metallic mineral products'' and ``metallic products, except machinery and equipment'' have distributions that are closer to the Gaussian shape.

Gráfico 3

ESTIMATED CONDITIONAL DENSITIES: CAPITAL-LABOUR RATIO - PRODUCTIVITY

Food and beverages — Food and beverages
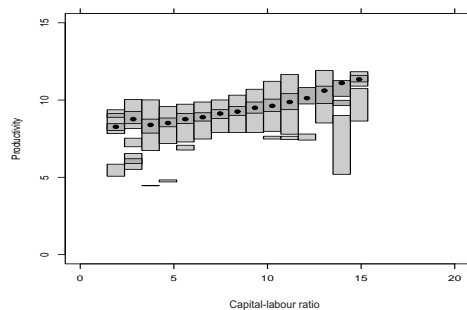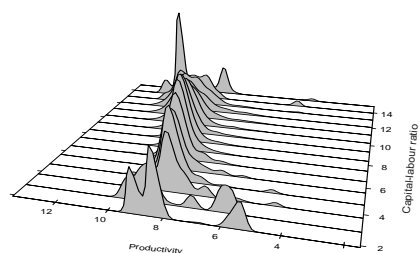
Clothing — Clothing

Non-metallic mineral products — Non-metallic mineral products

Metallic prod., except machinery and equip. — Metallic prod., except machinery and equip.

Source: Author's calculations based on a sample from IES.
Note: Variables in natural logarithms.

Gráfico 4

Food and beverages   **Food and beverages**

Clothing   **Clothing**

Non-metallic mineral products   **Non-metallic mineral products**

Metallic prod., except machinery and equip.   **Metallic prod., except machinery and equip.**

Source: Author's calculations based on a sample from IES.
Note: Variables in natural logarithms.

Chart 5

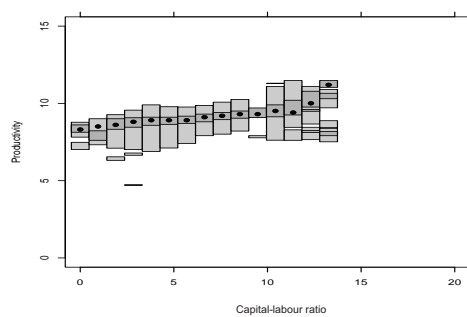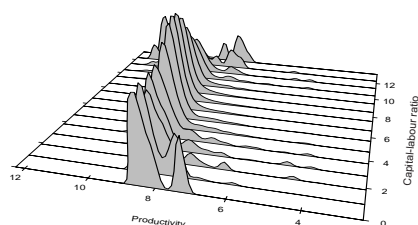ESTIMATED CONDITIONAL DENSITIES: SALES - CAPITAL-LABOUR RATIO

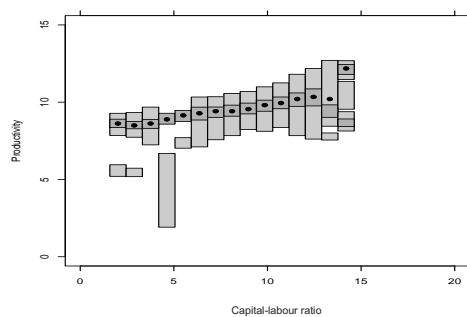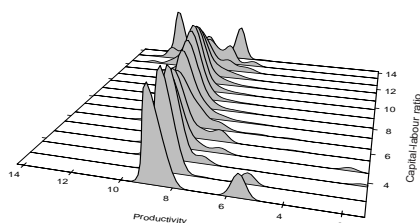Food and beverages | Food and beverages
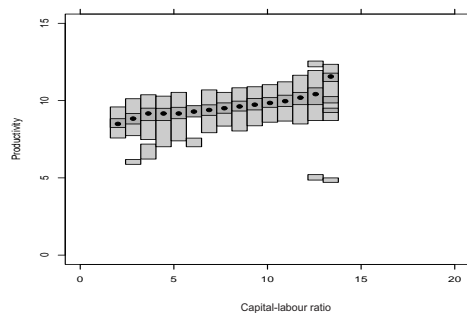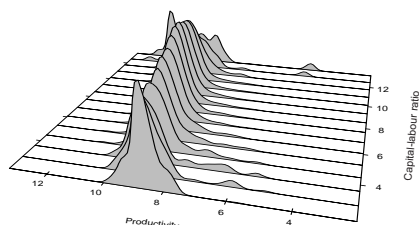

Clothing | Clothing

Non-metallic mineral products | Non-metallic mineral products
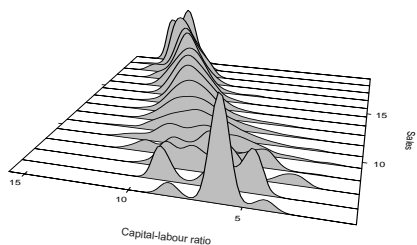
Metallic prod., except machinery and equip. | Metallic prod., except machinery and equip.

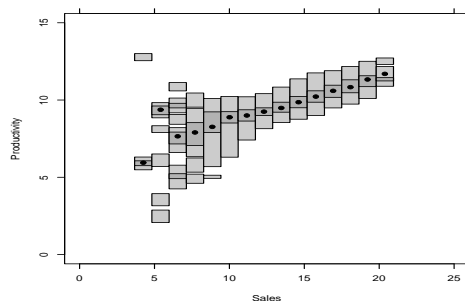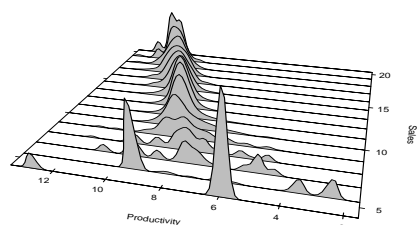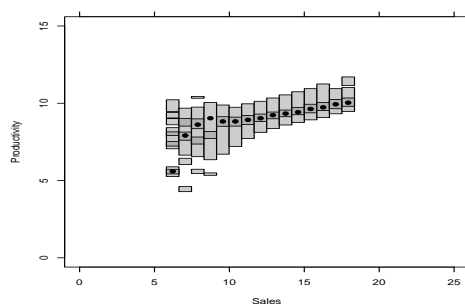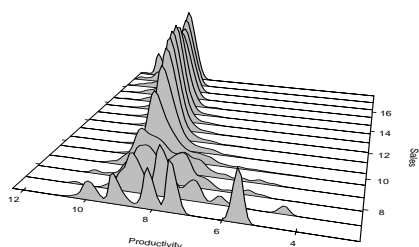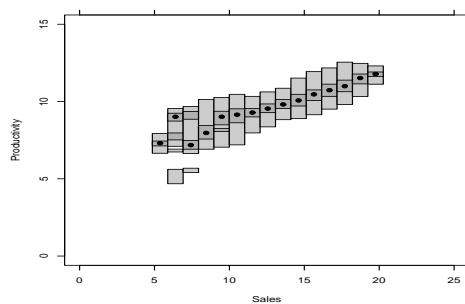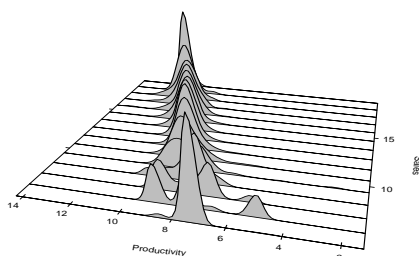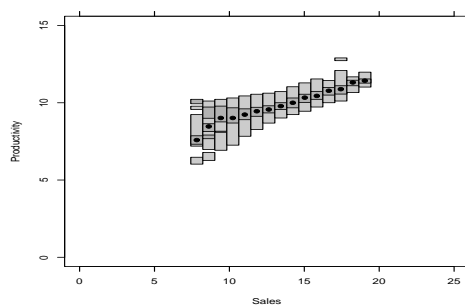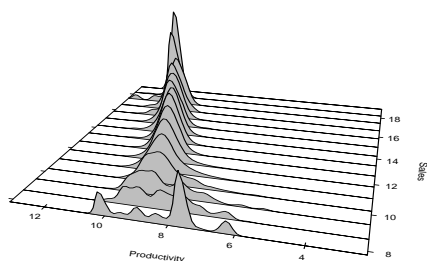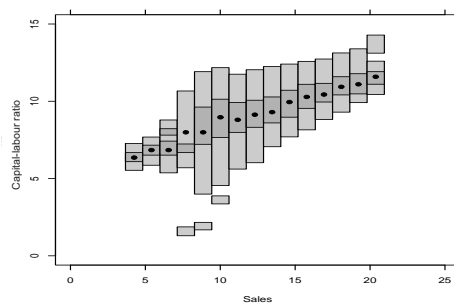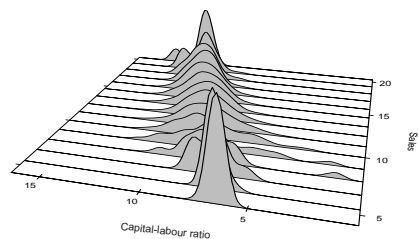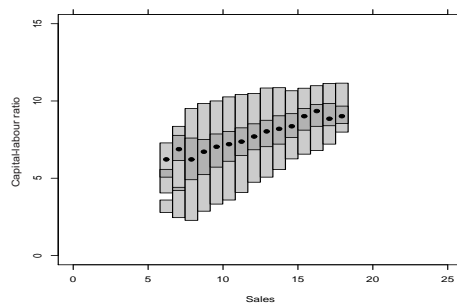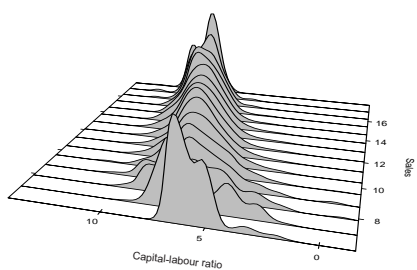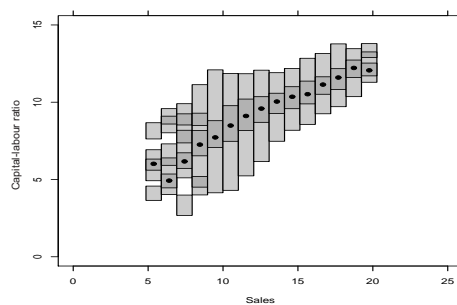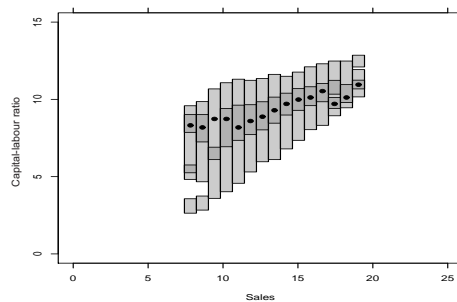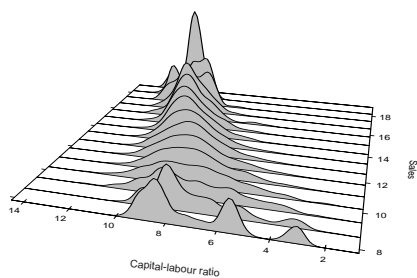**Source:** Author's calculations based on a sample from IES.
Note: Variables in natural logarithms.

As for the conditional distributions, there is a somewhat higher probability of finding high productivity firms amongst those with higher capital intensity and a clearly higher probability amongst those with higher sales. These two latter variables are also positively related as more capital intensive firms are found amongst those that are larger. Nevertheless, some specificities emerge in particular sectors. For example, there is a higher dispersion of productivity levels among those firms with lower levels of sales and this pattern is particularly strong in case of ``food and beverages'', where some small firms are more productive than very large ones. In addition, in this sector, the dispersion of capital-labour ratios is relatively low amongst firms with low levels of sales but increases significantly for medium-size firms.

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Appendix A

DESCRIPTIVE STATISTICS ACCORDING TO CAE - FIRM-LEVEL DATA

		GVA (thousand euro)					Workers					Capital (thousand euro)				
	CAE	pcr 25	Median	pcr 75	Average	Std dev	pcr 25	Median	pcr 75	Average	Std dev	pcr 25	Median	pcr 75	Average	Std dev
Food products and beverages	15	39.6	87.0	227.8	541.3	3 497.8	4	8	16	20	55	24.5	79.9	298.0	1073.6	10295.5
Tobacco	16	6 211.4	9 729.7	103 683.7	70 020.2	110 576.1	93	105	440	320	394	13 385.9	22 096.4	50 668.3	35 337.3	39 005.9
Textiles	17	38.6	104.2	304.1	442.6	1 278.5	4	9	22	26	66	14.2	68.4	316.9	618.1	2 520.4
Clothing	18	44.1	100.6	231.4	252.8	560.9	5	12	24	23	39	6.1	20.9	70.3	136.3	540.3
Leather and footwear	19	55.5	132.5	315.1	361.7	830.2	6	12	27	26	55	11.8	36.1	121.0	204.6	721.3
Wood and products of wood and cork, excep furniture	20	31.7	74.9	186.1	311.0	1 832.2	3	6	11	13	40	11.0	42.8	148.1	371.3	2 068.5
Pulp, paper, paper products	21	64.5	148.7	472.2	2 396.2	16 598.6	5	10	23	31	82	23.8	122.8	582.8	4874.0	42 862.2
Printing and publishing	22	25.6	63.2	175.8	351.1	1 892.7	2	4	9	11	36	6.7	31.7	127.0	352.5	2 755.4
Coke, refined petroleum products and nuclear fuel	23	41.0	118.2	17 865.2	90 042.4	222 689.4	3	5	31	303	770	13.7	354.1	44 662.9	123 861.4	290 034.2
Chemicals and chemical products	24	52.5	191.1	822.3	1 688.0	4 846.4	3	9	25	29	59	22.6	148.5	785.4	2134.0	7 272.8
Rubber and plastics products	25	63.6	191.8	622.9	975.5	7 215.6	4	10	26	28	70	35.4	183.9	657.3	952.6	3 406.5
Other non-metallic mineral products	26	43.5	108.0	308.7	707.1	4 563.0	4	7	16	21	66	21.2	102.4	408.2	1 067.5	6 111.5
Basic metals	27	57.0	182.3	1 011.3	1 700.9	5 445.6	4	10	36	41	77	15.8	120.1	781.9	1 784.9	4 875.2
Fabricated metal products except machinery and equipment	28	34.4	80.8	211.4	304.5	1 130.1	3	6	11	13	32	9.4	37.0	140.4	270.5	1 413.3
Machinery and equipment n.e.c	29	43.7	122.3	388.1	516.7	1 986.5	2	6	17	18	45	10.1	52.9	275.4	407.4	1 333.3
Office, accounting and computing machinery	30	39.8	86.3	774.2	932.9	2 345.4	2	7	17	24	59	25.5	166.4	425.0	307.3	404.5
Electrical machinery and apparatus n.e.c	31	35.9	97.0	341.2	1 167.3	6 049.3	2	6	16	36	185	6.7	36.0	214.3	719.6	3 355.5
Radio, television and communication equipment	32	39.5	146.8	944.4	3 361.6	12 139.6	2	6	35	72	241	6.6	48.4	769.5	3 008.1	14 955.8
Medical, precision and optical instruments	33	25.6	56.2	138.5	298.7	1 596.4	2	3	6	10	39	5.4	22.4	64.2	172.0	1 057.9
Motor vehicles, trailers and semi-trailers	34	66.5	183.8	837.0	2 708.7	13 381.4	5	12	40	71	213	14.8	114.0	968.9	3 159.8	20 683.1
Other transport equipment	35	32.5	120.3	340.6	1 045.6	4 576.1	3	7	20	41	171	6.0	33.2	194.1	850.8	6 061.2
Furniture	36	27.1	68.4	170.7	228.9	938.6	3	6	13	14	48	7.1	35.8	148.8	234.5	890.5
Manufacturing n.e.c; recycling	37	22.9	78.7	333.1	502.0	1 307.1	2	5	11	10	16	18.2	68.2	494.9	705.8	1 760.6
Total		36.9	91.8	252.3	530.0	4829.4	3	7	16	20	63	10.8	46.4	203.4	640.0	7 856.5

Source: Author's calculations based on a sample from IES.

Appendix A

DESCRIPTIVE STATISTICS ACCORDING TO CAE - FIRM-LEVEL DATA

CAE		Sales (thousand euro)					Capital-labour ratio (thousand euro)					Productivity (thousand euro)				
		pcr 25	Median	pcr 75	Average	Std dev	pcr 25	Median	pcr 75	Average	Std dev	pcr 25	Median	pcr 75	Average	Std dev
Food products and beverages	15	112.6	243.5	688.0	2687.1	17 304.0	4.1	10.7	28.4	32.2	86.0	8.3	11.7	17.0	16.1	19.5
Tobacco	16	16 653.0	17 369.3	219 049.9	151 345.4	233 295.3	80.4	102.4	156.4	123.8	78.2	63.2	92.7	174.0	127.2	114.8
Textiles	17	82.5	243.8	873.6	1 524.3	4 852.5	2.5	8.8	21.2	17.4	29.7	8.2	12.0	17.1	14.2	12.0
Clothing	18	70.6	163.9	438.6	713.6	2 350.8	0.7	1.9	4.8	5.6	17.6	7.3	9.0	11.4	10.4	8.0
Leather and footwear	19	106.1	262.4	792.0	1 226.4	3 332.9	1.3	3.2	7.1	8.8	34.7	8.5	10.8	14.2	13.2	15.3
Wood and products of wood and cork, excep furniture	20	91.0	228.3	670.4	1 352.2	8 673.6	2.6	7.9	19.0	16.8	30.6	9.6	13.5	19.3	16.3	13.4
Pulp, paper, paper products	21	189.8	553.5	2 031.0	7 453.6	45 643.6	4.5	13.4	36.2	34.5	73.3	11.1	16.6	26.2	23.2	31.2
Printing and publishing	22	68.6	162.6	431.4	897.0	4 570.5	2.2	8.7	23.7	21.2	78.7	10.8	16.5	25.4	21.0	25.5
Coke, refined petroleum products and nuclear fuel	23	105.1	587.4	21 128.6	953 583.4	2 503 996.2	4.4	70.8	282.3	417.2	831.2	8.5	39.4	234.8	191.5	295.9
Chemicals and chemical products	24	175.5	689.2	2 956.4	6 887.0	19 353.4	5.3	16.3	43.0	43.4	88.9	13.1	22.4	40.4	37.4	72.1
Rubber and plastics products	25	206.9	656.2	1 943.0	3 463.2	18 037.5	6.2	17.4	35.8	35.1	82.5	12.8	18.7	28.1	23.3	17.9
Other non-metallic mineral products	26	113.5	275.6	856.9	2 116.2	12 693.5	4.4	13.8	33.6	31.5	67.9	10.1	14.8	21.4	19.2	25.0
Basic metals	27	161.6	566.0	3 827.8	11 013.7	42 810.3	2.7	12.4	36.2	52.2	423.4	12.2	19.0	29.7	28.9	67.6
Fabricated metal products except machinery and equipment	28	101.0	227.1	577.2	985.5	4 954.3	2.2	6.8	17.6	14.5	24.4	10.5	15.0	21.1	17.4	12.6
Machinery and equipment n.e.c	29	108.2	310.7	1 016.9	1 596.9	7 609.8	2.6	9.2	24.3	23.2	118.3	14.2	21.1	29.2	24.6	39.4
Office, accounting and computing machinery	30	119.5	298.6	2 144.4	5 347.4	12 535.0	5.8	18.5	31.3	31.8	57.3	12.3	25.0	36.5	34.4	38.7
Electrical machinery and apparatus n.e.c	31	95.6	260.0	990.7	5 463.4	30 662.5	1.9	6.5	17.7	15.7	34.5	11.7	17.9	26.6	25.2	81.0
Radio, television and communication equipment	32	84.2	351.0	2 315.2	13 406.9	53 004.7	1.5	8.4	25.8	65.1	452.4	12.6	21.2	38.0	30.4	47.7
Medical, precision and optical instruments	33	57.3	131.4	319.8	881.3	5 240.5	1.7	6.8	16.8	13.4	18.8	12.4	18.2	25.9	21.2	15.1
Motor vehicles, trailers and semi-trailers	34	181.5	508.6	2 868.4	15 604.5	95 724.5	3.2	9.9	25.6	22.5	48.3	12.5	18.0	26.0	22.2	27.1
Other transport equipment	35	89.6	280.6	1 112.8	3 008.2	13 952.8	1.3	5.4	13.8	16.3	39.1	10.6	16.7	25.6	19.2	13.3
Furniture	36	74.5	179.5	478.3	786.6	5 114.5	1.7	6.1	15.6	14.1	40.6	7.8	11.2	16.0	13.3	12.1
Manufacturing n.e.c; recycling	37	86.7	305.4	1 448.9	2 780.9	9 105.9	6.3	17.9	47.6	48.9	118.0	9.4	18.2	36.1	29.7	36.6
Total		92.9	230.4	699.4	2 132.1	3 880.0	2.0	7.0	19.9	20.1	76.4	8.9	13.2	20.3	17.5	25.1

Source: Author's calculations based on a sample from IES.

IMMIGRANTS IN THE PORTUGUESE LABOUR MARKET*

Sónia Cabral** | Cláudia Duarte**

ABSTRACT

Using matched employer-employee data, we examine the main characteristics of immigrants in the Portuguese labour market in the 2002-2008 period. We find substantial differences in labour market outcomes between native and immigrant workers and among different nationality groups, in terms of age, gender, tenure, worker flows, geographical and sectoral concentration and education levels. As in other countries, the average wages of immigrants are lower than the wages of natives, even controlling for worker, firm and match characteristics, although growing at a higher pace in the period analysed.

1. Introduction

Portugal has traditionally been a country of emigration and significant immigration flows began more recently. Until the mid-nineties, immigration in Portugal was relatively modest in international terms, comprising mainly nationals from Portuguese speaking countries. In the late nineties, immigration accelerated, driven by high and unmet labour demand resulting from the strong dynamics in the construction sector, linked with major infrastructure projects, and in some services sectors. Most of these recent immigration flows in Portugal were of irregular nature, as evinced by the series of regularisations that occurred since 2000. There was also a change in the composition of the flow of immigrants, with a substantial share of this recent immigration originating from Central and Eastern European countries, with no apparent link with Portugal, and also from Brazil.

In international terms, the share of immigrants in total population in Portugal is relatively low. Nevertheless, as in other Southern European countries, like Spain and Italy, and in other new immigration countries in Europe, such as Ireland and Greece, immigration in Portugal is a recent phenomenon. Since recent immigrant flows in Portugal were linked with employment opportunities, they tend to have a high labour market attachment. Portugal has one of the highest employment rates of immigrants among OECD countries, higher than that of natives for both men and women. However, immigrants in Portugal also seem to be more affected than natives by downturns in economic activity. The unemployment rate of immigrants is always higher than that of natives since 1998 and it increases faster in periods of economic recession.

At present, empirical evidence on immigration in the Portuguese labour market is relatively scarce, probably also reflecting the novelty of the phenomenon. Some exceptions are Carneiro *et al*. (2010) who study the determinants of earnings of immigrants in 2003-2004 using a longitudinal database and OECD (2008) that provides a comprehensive analysis of the main features of recent immigration in Portugal.

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This article aims at contributing to this literature, by providing a detailed portrait of recent immigration in the Portuguese labour market. It adopts a fully empirical approach, describing and examining the main characteristics of immigrant workers in Portugal, with an emphasis on wages. As foreign-born individuals with Portuguese nationality should not be considered as migrants, since they share most of the relevant characteristics with the native population, our definition of immigrants throughout this article follows a nationality criterion. We use matched employer-employee data from a longitudinal dataset (*Quadros de Pessoal*) from 2002 to 2008, focusing the analysis in the full-time employees segment and differentiating the results by main nationality groups within immigrant workers. All workers in illegal and irregular situations are, by definition, excluded from the analysis leading to an underestimation of immigrants in the Portuguese labour market. A comparative analysis of wage developments (levels and growth) for natives and major immigrant groups over the period is included, with a breakdown by main sectors of activity of immigrant employment.

The article is organized as follows. Section 2 describes the database and the main features of immigrants relative to those of native workers. Section 3 focuses on comparing the wages of immigrants and natives. Finally, section 4 presents some concluding remarks.

2. Main characteristics of employed immigrants in Portugal

The database used in this article is *Quadros de Pessoal* (*QP*), a longitudinal dataset matching workers and firms based in Portugal. The worker-level data covers all years since 1982, except for 1990 and 2001, but information on the nationality of the worker only starts in 2000, so our sample period starts in 2002 and ends in 2008. The exact nationality at the country level of the worker is the only information available that helps to identify migrant workers in *QP*, since neither the place of birth nor the year of arrival in Portugal are recorded. Nevertheless, given the nature of recent immigration in Portugal and the low naturalisation rate, this seems a reasonable approximation of the target population.

OECD data based on residence permits estimates that the foreign population in Portugal amounts to around 440 thousand individuals in 2008, while immigrant workers in the *QP* database used here are about 170 thousands (Table 1). The *QP* dataset does not cover domestic work. This fact can have some impact on the results since many foreign women in Portugal are linked to this sector. In addition, all workers in illegal and irregular situations are excluded from the analysis given the lack of information on these individuals in the *QP* database, leading to an underestimation of immigrants in the Portuguese labour market. Nevertheless, the detailed characteristics of the *QP* database make it especially suitable to study the evolution of immigration in the Portuguese labour market. Peixoto (2008) and Carneiro *et al*. (2010) also use the *QP* to examine different aspects of recent immigration flows in Portugal. Peixoto (2008) provides a descriptive analysis of employed immigrants in 2004 and Carneiro *et al*. (2010) study the assimilation of immigrants in the Portuguese labour market in 2003-2004. In addition, OECD (2008) provides a very comprehensive study of the main features of immigration in the Portuguese labour market using different databases including the *QP*.

Dependent employment constitutes the main contractual form in the Portuguese labour market, representing 92 per cent of total employment for natives and 94.7 per cent for immigrants in 2008 (Table 1).[1] Full-time contracts have a similar incidence between natives and immigrants but immigrants have a higher proportion of part-time jobs. In 2008, a higher percentage of natives appears as employers, 7.4 per cent compared to 4.8 per cent for immigrants. The lower share of immigrants in self-employment in Portugal contrasts with evidence found in other countries where immigrants tend to be over-represented among the self-employed (see, for instance, Andersson and Wadensjo (2004)). In the Portuguese

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[1] Table 1 includes only information for 2008, but the employment structure is similar over the 2002-2008 period. All yearly data is available from the authors upon request.

Table 1

EMPLOYMENT STATUS OF NATIVES AND IMMIGRANTS, 2008 | LEVELS AND SHARES							
	Immigrants	Total		Natives		Immigrants	
	Share in total	Level	Share	Level	Share	Level	Share
Employer	4.1	200 226	7.3	191 965	7.4	8 261	4.8
Unpaid family worker	5.1	1 039	0.0	986	0.0	53	0.0
Employee	6.4	2 540 078	92.2	2 376 675	92.0	163 403	94.7
Full-time	6.3	2 409 333	87.5	2 258 521	87.5	150 812	87.4
Part-time	9.6	130 745	4.7	118 154	4.6	12 591	7.3
Other	6.6	13 597	0.5	12 705	0.5	892	0.5
Total	6.3	2 754 940	100	2 582 331	100	172 609	100

Sources: *Quadros de Pessoal* and authors' calculations.

Note: In the case of full-time employees, we only considered those that reported a base wage above 80 per cent of the minimum legal wage.

labour market, the most notable difference between immigrants and natives relates to the nature of the contract, *i.e.*, permanent versus fixed-term (Chart 1). Considering only full-time employees, 51.7 per cent of immigrant workers had fixed-term contracts, which are typically associated with jobs with lower wages, compared to 24.6 per cent for native employees in 2008. However, fixed-term contracts have been steadily gaining importance in the employment structure of native workers over this period, which can be seen as a consequence of the relative rigidity of permanent contracts in Portugal (see, for instance, Portugal (1999)). By main nationality groups, the proportion of workers with fixed-term contracts in 2008 is the highest for Brazilians (63.6 per cent) and it increased since 2006. An increasing incidence of temporary contracts is also evident in workers from China though less markedly. Immigrants from Central and Eastern European countries (CEEC) have also a significant share of fixed-term contracts but it declined over this period from 67.1 per cent in 2002 to 56.9 per cent in 2008.[2] Immigrants from Portuguese speaking countries in Africa (*PALOP*) have a below average percentage of fixed-term contracts but it rose since 2005, from 40 per cent to 45.4 per cent in 2008.[3] Finally, immigrants from the other 14 initial Member-States of European Union (EU15) have a much lower proportion of temporary contracts over the whole period (around 30 per cent).

The remainder of the analysis of this article will focus on the full-time employees segment. In this case, we only considered the workers that reported a base wage above 80 per cent of the minimum legal wage. Full-time employed immigrants in Portugal increased by 46.2 per cent in cumulative terms from 2002 to 2008, an average annual growth rate of 6.5 per cent. Hence, the share of immigrants in full-time employees in Portugal increased from 5.2 per cent in 2002 to 6.3 per cent in 2008. Immigrants from Brazil had an impressive growth of 161 per cent in cumulative terms over this period (average annual rate of 17.3 per cent), which translated into an increase of their share in total immigrant employees from 15.1 per cent in 2002 to 26.9 per cent in 2008 and made them the major single nationality group in Portuguese dependent employment (Chart 2). Immigrants from China also grew steadily over this period, but still represent a small proportion of total immigrants in Portugal (less than 2 per cent in 2008). On the contrary, the number of immigrants from the CEEC remained almost stable over this period, showing even negative rates of change since 2006, in line with the slowdown of economic activity in some sectors. The strong inflows from the CEEC at the end of the nineties were largely driven by labour market opportunities, especially in the construction sector. Immigrants from Ukraine, the major nationality within the CEEC, declined by 18.1 per cent in cumulative terms over the 2002-2008

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2   CEEC (Central and Eastern European countries) in the *QP* database includes Slovakia, Poland, Czech Republic, Hungary, Estonia, Slovenia, Latvia, Lithuania, Romania, Russian Federation, Moldova, Ukraine and Serbia.

3   *PALOP* (*Países Africanos de Língua Oficial Portuguesa*) refers to the former Portuguese colonies in Africa (Angola, Cape Verde, Guinea Bissau, Mozambique, and São Tomé and Príncipe).

Chart 1

PERMANENT AND FIXED-TERM CONTRACTS OF NATIVES AND IMMIGRANTS IN PORTUGAL | SHARES IN TOTAL FULL-TIME EMPLOYMENT

Permanent and fixed-term contracts | **Fixed-term contracts**
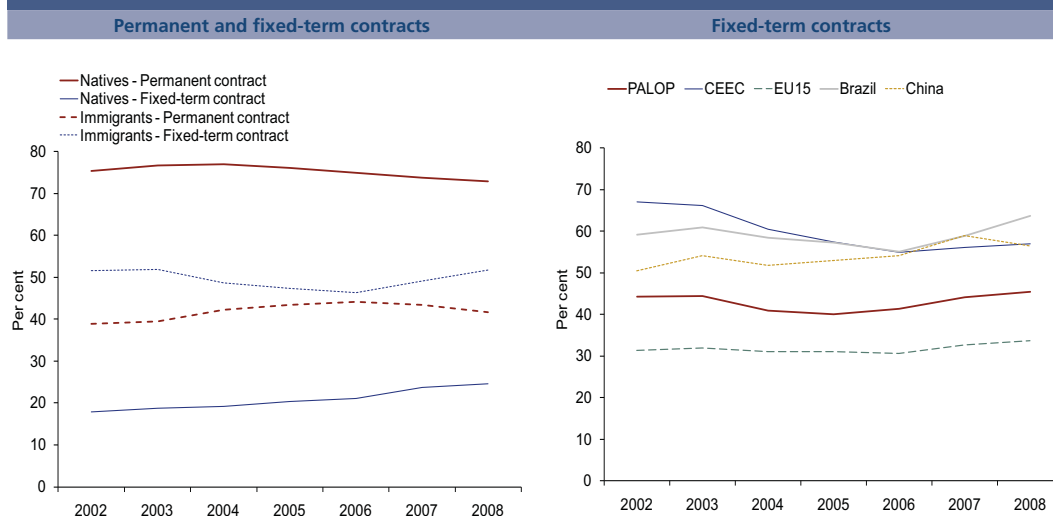
Sources: *Quadros de Pessoal* and authors' calculations.

Chart 2

MAIN NATIONALITIES OF IMMIGRANT EMPLOYMENT IN PORTUGAL

Cumulative growth | **Shares in total**
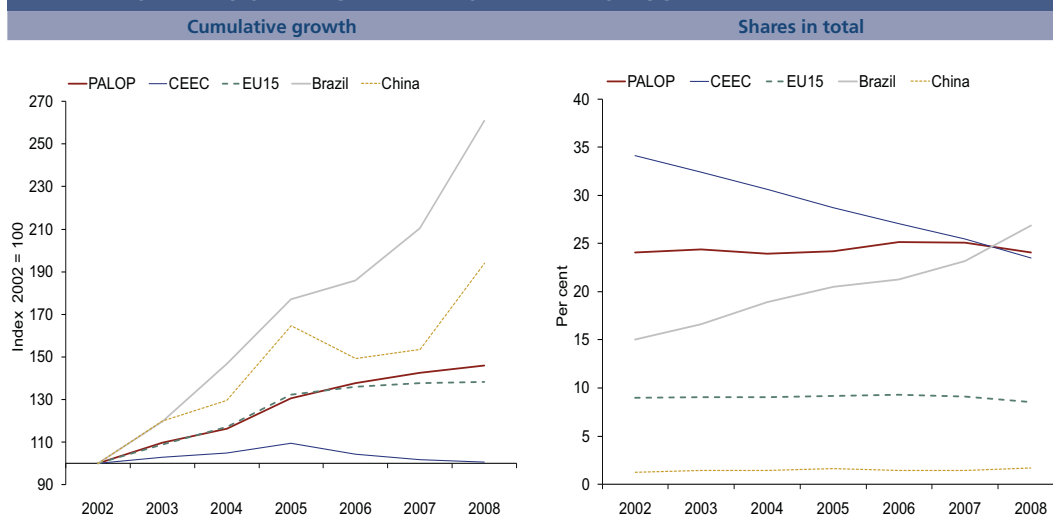
Sources: *Quadros de Pessoal* and authors' calculations.

period, accounting for 13.1 per cent of total immigrants in 2008 (23.3 per cent in 2002). In contrast, inflows from Romania, the second major CEEC origin, continued to grow over this period, with its share in total full-time immigrant workers increasing from 3.9 per cent in 2002 to 4.5 per cent in 2008. Immigrants from the *PALOP* maintained their share in total around 24 per cent over this period, but there was a decline in the share of employees from Angola (to 7.6 per cent in 2008) and an increase in the percentage of immigrants from Cape Verde (to 8.1 per cent in 2008). Finally, immigration from the EU15 grew slightly below average, in particular since 2007, resulting in a small decline of its share in total from 9 per cent in 2002 to 8.5 per cent in 2008. Within the EU15, the main countries of origin of immigrants are France, Spain, Germany and the United Kingdom. Summing up, immigration in Portugal is currently rather concentrated in three main geographical origins, Brazil, *PALOP* and CEEC, each with a share above 20 per cent of total and representing together 74.5 per cent of total full-time immigrant employees in 2008 (73.3 per cent in 2002).

As mentioned in other studies, immigrant workers in Portugal are slightly younger than natives (Table 2). Full-time employees with less than 35 years account for 44 per cent of total natives but represent 50.5 per cent of immigrants in the period 2002-2008. This difference is higher in the case of workers from China and, especially, from Brazil. In the case of Brazilian workers, 62.5 per cent of them have less than 35 years and almost 50 per cent is aged between 25 and 34 years. The percentage of females in immigrant employment is lower than in native employment, representing 34.8 and 43.1 per cent of total in this period, respectively. However, the exclusion of domestic work from the analysis tends to underestimate female employment in Portugal. For instance, OECD data based on residence permits of the foreign population in Portugal shows a percentage of females of 40.6 per cent on average in the period 2002-2008 (47.3 per cent in 2008). Looking at the main origins of immigrants, the share of female workers is higher in the case of the EU15 and Cape Verde (43.3 per cent in both cases) and lower in the case of the CEEC and, particularly, Ukraine (23.6 per cent). However, from 2002 to 2008 there was an increase in the proportion of females in dependent employment in Portugal, common to all main nationalities but particularly sharp in the case of immigrants from the CEEC (Chart 3). The share of female workers from the CEEC increased from 20.3 per cent in 2002 to 29.5 per cent in 2008.

As could be expected given the recent nature of most immigrant flows in Portugal, the tenure of immigrant workers is much lower than that of natives, average of 2.4 and 7.4 years in the same job over the period 2002-2008, respectively (Table 3). Within immigrants, tenure is higher for workers from the EU15 and, to a lesser extent, from Cape Verde, which are the immigrant groups that have been longer in the country. The average tenure for other nationality groups is less than 2 years in this period. The proportion of immigrants with tenure less than 1 year is 37.7 per cent, which is more than double the share of natives in the same situation (15.9 per cent on average in this period). In the period 2002-2008, 44 per cent of native workers have tenure up to 3 years, but that proportion increases to 78.7 per cent in the case of immigrants. This result is in line with the higher incidence of temporary contracts, mostly with a length of 3 years, in immigrant employment. The share of immigrants with tenure up to 3 years is especially high in workers from China and Brazil, 89.7 and 88.2 per cent on average for the period 2002-2008, respectively. A high percentage of workers from the CEEC also shows a tenure less than or equal to 3 years on average, but that proportion declined steadily over the period, from 98.7 per cent in 2002 to 76 per cent in 2008 (Chart 4). For workers from Brazil and China, the percentage of individuals with tenure up to 3 years declined until 2006, but remained stable afterwards at above 84 per cent. In 2008, 52.1 per cent of Brazilian workers had tenure inferior to 1 year and that share increased strongly in the last two years, while in the case of Ukraine that share decreased over the period to 35.5 per cent

Table 2

AGE AND GENDER OF NATIVE AND IMMIGRANT EMPLOYEES IN PORTUGAL, AVERAGE 2002-2008 | SHARES, PER CENT									
	Natives	**Immigrants**							
			EU15	*PALOP*		**CEEC**		**Brazil**	**China**
					Cape Verde		**Ukraine**		
AGE									
Average	37.8	35.7	36.4	36.5	37.5	36.3	37.2	33.0	34.3
15-24	10.7	10.2	8.3	9.6	12.6	7.6	5.6	15.2	12.3
25-34	33.3	40.3	43.0	36.0	29.1	39.7	37.8	47.3	41.5
35-44	28.2	30.7	27.9	34.0	31.1	31.6	33.2	26.6	34.0
45-54	19.3	15.4	13.8	16.7	21.8	18.7	20.7	9.4	10.8
55+	8.6	3.4	7.1	3.7	5.5	2.3	2.7	1.5	1.5
	100	100	100	100	100	100	100	100	100
GENDER									
Men	56.9	65.2	56.7	59.4	56.7	75.5	76.4	61.4	64.4
Women	43.1	34.8	43.3	40.6	43.3	24.5	23.6	38.6	35.6
	100	100	100	100	100	100	100	100	100

Sources: *Quadros de Pessoal* and authors' calculations.

Chart 3

PROPORTION OF FEMALES IN IMMIGRANT EMPLOYMENT BY MAIN NATIONALITIES | SHARES IN TOTAL
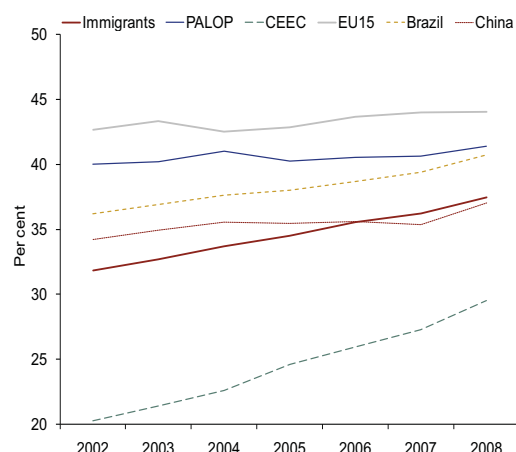
Sources: *Quadros de Pessoal* and authors' calculations.

Chart 4

IMMIGRANT EMPLOYEES WITH TENURE UP TO 3 YEARS BY MAIN NATIONALITIES | SHARES IN TOTAL
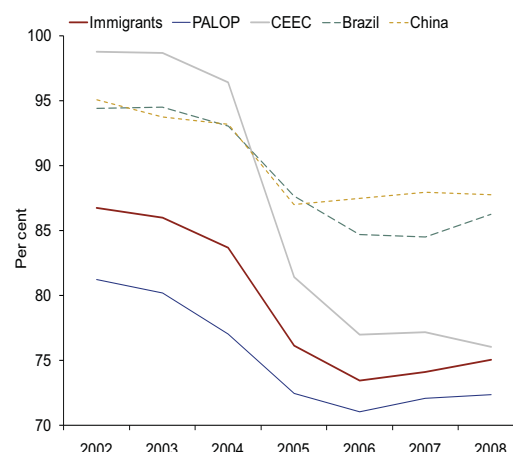

Sources: *Quadros de Pessoal* and authors' calculations.

Table 3

TENURE OF NATIVE AND IMMIGRANT EMPLOYEES IN PORTUGAL, AVERAGE 2002-2008	SHARES, PER CENT								
	Natives	**Immigrants**						**Brazil**	**China**
			EU15	*PALOP*		**CEEC**			
					Cape Verde		**Ukraine**		
[0, 3]	44.0	78.7	61.7	74.7	73.5	86.4	85.0	88.2	89.7
of which: 0	15.9	37.7	24.1	37.6	34.9	38.7	36.0	47.1	44.1
[4, 6]	16.9	12.1	17.8	13.1	13.2	11.2	12.2	8.5	7.8
[7, 9]	10.8	3.9	8.8	5.2	5.2	1.4	1.5	1.7	1.5
[10, 19]	18.9	4.1	9.6	5.6	5.8	0.4	0.5	1.3	0.8
≥20	9.4	1.3	2.1	1.3	2.3	0.5	0.8	0.3	0.1
	100	100	100	100	100	100	100	100	100
Average years	7.4	2.4	4.1	2.8	3.1	1.6	1.8	1.4	1.3

Sources: *Quadros de Pessoal* and authors' calculations.

in 2008. Although this evolution can suggest that migrants from the CEEC have a higher probability of maintaining a job once they get it, it also reflects the very strong growth of recent migration flows from Brazil in the last two years. A precise analysis of the differences in labour market outcomes of the various nationality groups requires controlling for a broad range of characteristics that differentiate them. As no such control for heterogeneity is made here, these descriptive statistics should be interpreted with caution.

An analysis of worker flows offers a complementary perspective of immigrant employment, examining the allocation of workers through hires and separations. Even when aggregate employment does not change, workers move between jobs or enter/exit the labour force, so worker rotation rates exceed the rates of job creation and destruction (see Centeno *et al.* (2008) for a detailed analysis of worker and job flows in the Portuguese labour market). Following Burgess *et al.* (2000), total worker flows or turnover refer to all movements of workers into and out of jobs, *i.e.*, the sum of hires and separations occurring between two years, and job flows are computed as net job changes, *i.e.*, the difference between hires and separations. To obtain the corresponding rates, flows are divided by total average employment in the two years. In the 2003-2008 period, worker rotation rates in Portugal are higher for immigrants than for natives, with both hiring and separation rates showing higher values (Chart 5). This result is in line with

Chart 5

HIRING AND SEPARATION RATES OF NATIVE AND IMMIGRANT EMPLOYEES IN PORTUGAL	
Natives and immigrants	**By nationalities, average 2003-2008**
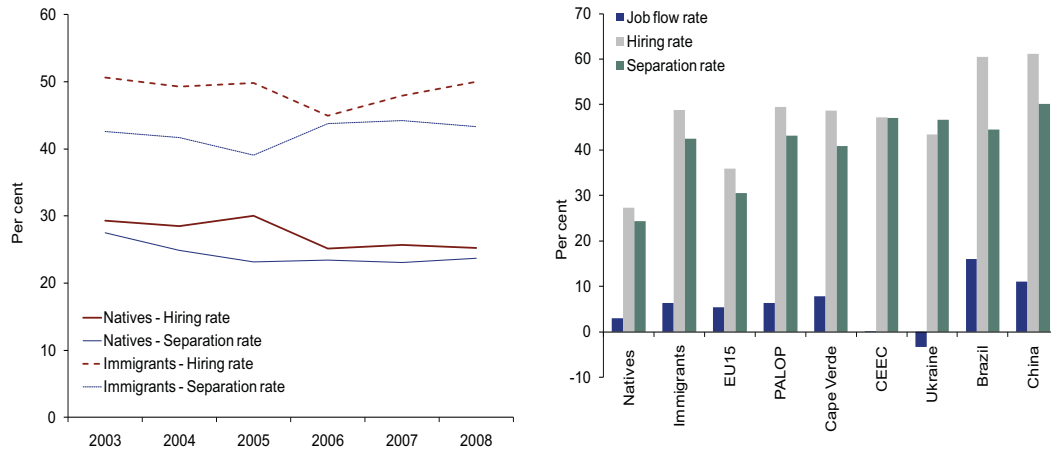
Sources: *Quadros de Pessoal* and authors' calculations.

the evidence in Centeno *et al*. (2008) that worker flows are higher among younger worker and workers with fixed-term contracts. By main nationality, Chinese immigrants have particularly high rotation rates, with the highest hiring and separation rates over the period. The hiring rate of immigrants from Brazil is also above 60 per cent, which partly translates into an important net job creation. In contrast, the hiring rates of workers from Ukraine are smaller that their separation rates, leading to a net job destruction over this period. Among immigrants, workers from the EU15 have the lowest rates of worker flows, but still above those of natives.

As discussed in Burgess *et al*. (2000), strong worker flows can coexist with a stable core of workers that remain in the same firm throughout the whole period. Chart 6 depicts the retention rates by main nationalities, defined as the percentage of workers who were employed at the beginning of the period, and remain in the same firm at the end of the period. It shows that around 30 per cent of natives that were employed in 2002 remained in the same firm until 2008, but that share decreases sharply to 12.9 per cent for immigrants, not controlling for other factors that differentiate them. Within immigrants, the retention rate is the highest for workers from the EU15 and the lowest for workers from China, in line with the magnitude of worker flows for these immigrant groups. The percentage of immigrants from the CEEC and Brazil that were still employed by the same employer after 7 years amounts to 7.8 and 10 per cent, respectively. Given the higher worker flows of Brazilian employees it could be expected that the retention rate would be lower for them than for workers from the CEEC. However, from 2002 to 2008, the number of Brazilian employees in Portugal grew strongly, while workers from the CEEC remained stable and these different trends affect the comparison of their retention rates. The extent of this influence becomes clearer if the group of workers that remained in the same firm over the whole period is divided by total employees in 2008, instead of in 2002. In this case, only 3.8 per cent of Brazilians that are employed in 2008 were already working in the same firm in 2002, compared to 7.8 per cent for workers from the CEEC.

Table 4 shows the regional distribution of immigrants within the country in comparison with native workers in the 2002-2008 period. The top 3 districts for each nationality group are highlighted in table 4, with Lisboa being the main location for all nationality groups considered. In the case of immigrants, the main three locations in Portugal are Lisboa, Faro and Porto, but Setúbal is also an important location. This regional distribution is different from that of natives which are more widespread across the

Chart 6

| WORKERS EMPLOYED IN THE SAME FIRM FROM 2002 TO 2008 | SHARES IN TOTAL |
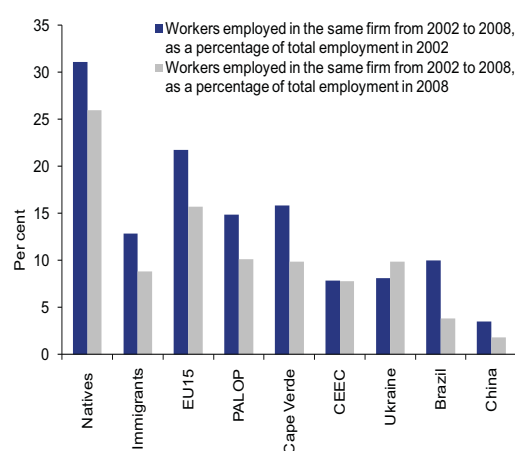
Sources: *Quadros de Pessoal* and authors' calculations.

Table 4

GEOGRAPHICAL LOCATION OF NATIVE AND IMMIGRANT EMPLOYEES IN PORTUGAL, AVERAGE 2002-2008	SHARES, PER CENT								
	Employment (rate of change)	Natives	Immigrants					Brazil	China
				EU15	PALOP		CEEC			
						Cape Verde		Ukraine		
Aveiro	1.8	7.4	4.2	4.2	1.8	0.6	5.4	6.7	3.1	3.0
Braga	2.6	**8.9**	3.3	4.5	1.5	0.5	3.6	4.6	2.1	2.7
Faro	6.0	3.2	**11.7**	**18.6**	6.0	**7.5**	**18.0**	**15.9**	9.4	**13.1**
Leiria	3.0	4.5	4.5	5.2	1.8	1.9	**7.9**	**10.2**	3.5	2.8
Lisboa	3.6	**31.7**	**45.3**	**34.2**	67.5	69.9	32.4	28.6	53.0	37.3
Porto	3.2	**18.8**	**9.5**	12.2	6.2	4.9	7.1	8.2	8.4	**16.9**
Santarém	2.5	3.5	3.3	2.8	1.5	0.9	5.8	6.8	2.9	4.9
Setúbal	2.2	4.6	7.3	3.9	**8.8**	**10.2**	6.7	4.9	**8.9**	7.0
Other	3.6	17.4	11.0	14.4	4.8	3.6	13.0	14.1	8.6	12.3
Total	3.3	100	100	100	100	100	100	100	100	100

Sources: *Quadros de Pessoal* and authors' calculations.
Note: The rate of change of employment refers to the annual average rate of change of total employment (natives and immigrants) over the period 2002-2008, in per cent.

country and relatively more concentrated in the North of the country, with Porto and Braga being major locations for native employment. Immigrants are relatively more concentrated than natives in the Lisboa district, a district whose total employment grew above average in this period. The second major location of immigrant workers, Faro, had also a strong increase in total employment, the highest of the districts included in table 4. Immigrants from the *PALOP* are heavily concentrated in the Lisboa and Setúbal districts, especially in the case of Cape Verde (80.1 per cent of immigrant workers from Cape Verde are located in these two districts). Workers from Brazil are also very concentrated in Lisbon (53 per cent of total), with Faro, Setúbal and Porto appearing also as important locations in this period. Porto is the second major location for Chinese immigrants, with an above-average share of 16.9 per cent, followed by Faro with 13.1 per cent. Workers from the CEEC are relatively more concentrated in Faro, with Leiria appearing as the third major district for these workers. Faro is also an important location for immigrants from the EU15, accounting for 18.6 per cent of total workers from these countries in the period 2002-2008.

Immigrant employment in Portugal is concentrated in a few sectors, namely construction and some services activities. In contrast, the share of the manufacturing industry in total immigrant employment is much lower than that in native employment (15.9 and 28.8 per cent on average in the 2002-2008 period, respectively) and declined from 2002 to 2008 (Table 5 and Chart 7). The main sector of immigrant employment in Portugal is the construction sector, accounting for 23.9 per cent of the total employment of immigrants in this period (11.5 per cent for natives). The construction sector is especially relevant for male immigrants as 35.5 per cent of them are employed in this sector (18.4 per cent for native males) and for immigrants of the *PALOP* and, mostly, the CEEC. The high concentration of immigrants in the construction sector reflects the fact that recent immigration flows in Portugal were partly driven by strong demand in this sector. However, the proportion of immigrants employed in construction declined over the 2002-2008 period, in line with the deceleration of activity in this sector, but the share of native employment remained virtually stable. This fact points to a higher sensitivity of immigrants employment to the evolution of activity in this sector.

In the period 2002-2008, the employment share of the services sector as a whole is very similar for natives and immigrants, representing almost 60 per cent of total in both cases, and has been increasing over time reflecting the shift to services observed in most advanced economies since the eighties. However, the breakdown within services is very different for natives and immigrants in Portugal. Immigrants are especially concentrated in three sub-sectors: hotels and restaurants, real estate and business services, and wholesale and retail trade. The first two sub-sectors represent individually around 15 per cent of total immigrant employment in this period, a share much higher than that of natives. Both sub-sectors recorded also an increase of immigrant employment from 2002 to 2008. These two sub-sectors are particularly significant for female immigrants, with shares in total female immigrant employment of 27.7 percent for hotels and restaurants and 17.4 per cent for real estate and business services in this period. Within the real estate and business services, the major sub-sectors of immigrant employment are industrial cleaning and labour recruitment and provision of personnel, which includes temporary work agencies. This sub-sector employs an especially high share of immigrants from the *PALOP* (22.9 per cent on average in the period), in particular in cleaning services. Around 15 per cent of immigrants from Brazil also work in real estate and business services, but particularly in temporary work agencies. Immigrants from China and, to a lesser extent, Brazil are relatively more concentrated in hotels and restaurants (average shares of 46 per cent and 23.7 per cent, respectively). A significant percentage of immigrants works in wholesale and retail trade (13.5 per cent compared to 20 per cent for natives in the period 2002-2008) and this share remained almost stable over this period. Female immigrants are relatively more concentrated in this sub-sector than male immigrants (shares in total of 17 and 11.7 per cent, respectively), while for native workers the proportions between men and women are similar (around 20 per cent). Immigrants from China are predominantly employed in wholesale and retail trade, accounting for 50 per cent of total on average in this period. A higher than average share of employment in this sub-sector is also found for immigrants from the EU15 (19.7 per cent). Workers from the EU15 are also more concentrated in education and health than immigrants from other origins.

Table 6 compares the educational attainment of natives and immigrants in the Portuguese labour market using the International Standard Classification of Education (ISCED) categories. The differences between the levels of formal education of natives and immigrants as a whole are small. The percentage of immigrant workers with very low education levels is lower than the corresponding figure for native workers (44.1 and 46.9 per cent, respectively), but the share of illiterates is higher for immigrants. Immigrants with a high education level (tertiary education) represent also a smaller proportion of total than that of natives, while the percentage of immigrants with low and medium education levels is higher than that of native workers. However, these aggregate education levels conceal important differences between the main immigrant groups. Immigrants from Cape Verde and China stand out as having an extremely low educational attainment. 71.3 per cent of immigrants from Cape Verde have a very low education level (primary education or less), with 8.7 per cent of illiterates, and only 2.3 per cent of them have tertiary
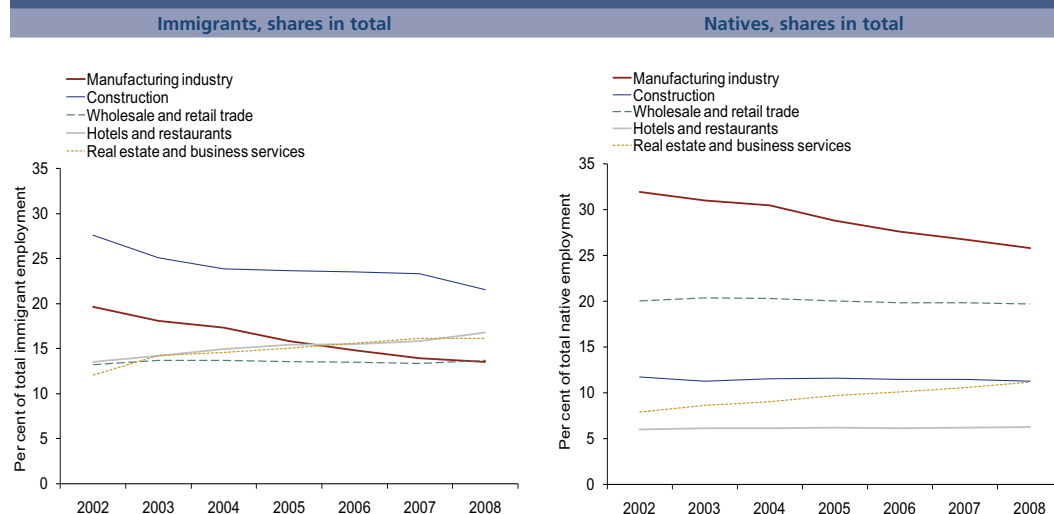
Table 5

MAIN SECTORS OF ACTIVITY OF NATIVE AND IMMIGRANT EMPLOYEES IN PORTUGAL, AVERAGE 2002-2008 | SHARES, PER CENT

ISIC code		Natives	Immigrants	EU15	PALOP	CEEC	Brazil	China	Males		Females	
									Natives	Immigrants	Natives	Immigrants
1+2+5	Agriculture, forestry and fishing	1.6	2.6	1.9	0.6	5.2	1.7	0.3	1.8	2.7	1.3	2.3
10-14	Mining and quarrying	0.5	0.4	0.4	0.2	0.9	0.1	0.0	0.8	0.7	0.1	0.1
15-37	Manufacturing industry	28.8	15.9	20.8	8.9	22.0	10.8	1.0	28.5	17.0	29.1	13.8
15-16	Food products, beverages and tobacco	3.6	2.8	2.2	1.8	3.7	2.8	0.0	3.4	2.3	3.9	3.8
17-19	Textiles, clothing, footwear and leather	8.6	2.4	4.0	0.6	2.4	0.7	0.5	4.4	1.6	14.1	3.9
20-22	Wood, cork and paper	3.1	1.5	1.9	0.9	1.9	1.0	0.1	3.8	1.7	2.2	1.0
23-25	Chemicals, including energy	1.9	1.1	1.6	0.7	1.5	0.8	0.1	2.2	1.2	1.5	0.9
26-28	Minerals and metals	5.1	4.3	4.2	2.3	7.7	2.5	0.0	7.0	5.7	2.7	1.7
29-33	Machinery and equipments	3.0	1.7	3.0	1.2	1.9	1.5	0.1	3.5	2.1	2.2	1.1
34+35	Transport equipment	1.6	1.2	2.5	0.9	1.5	0.9	0.0	1.9	1.3	1.1	0.9
36+37	Other manufacturing	1.8	0.9	1.4	0.5	1.4	0.6	0.2	2.3	1.1	1.3	0.6
40+41	Electricity, gas and water supply	0.6	0.1	0.1	0.1	0.1	0.1	0.0	0.9	0.1	0.2	0.1
45	Construction	11.5	23.9	8.1	29.1	32.3	19.4	0.5	18.4	35.5	2.3	2.2
50-99	Services	57.1	57.1	68.7	61.1	39.5	68.0	98.2	49.6	44.1	67.0	81.5
50-52	Wholesale and retail trade	20.0	13.5	19.7	11.1	9.0	15.8	50.0	19.5	11.7	20.7	17.0
55	Hotels and restaurants	6.1	15.3	11.4	14.6	10.7	23.7	46.0	4.2	8.7	8.7	27.7
60 a 64	Transports and communications	5.9	4.3	5.5	2.5	5.3	4.6	0.2	8.1	5.6	3.0	1.7
65-67	Financial intermediation	3.2	0.8	2.2	1.4	0.1	0.5	0.0	3.2	0.6	3.2	1.1
70-74	Real estate and business services	9.6	15.0	12.9	22.9	10.3	14.7	0.9	9.4	13.7	10.0	17.4
75	Public administration	0.9	0.3	0.4	0.4	0.1	0.2	0.0	0.8	0.2	1.1	0.4
80	Education	1.9	1.1	4.9	0.8	0.3	0.5	0.2	0.8	0.5	3.4	2.2
85	Health and social work	5.8	3.6	7.1	4.6	1.4	3.3	0.1	1.2	0.9	11.9	8.7
90-99	Other services	3.6	3.3	4.6	2.9	2.4	4.6	0.8	2.4	2.2	5.1	5.2
		100	100	100	100	100	100	100	100	100	100	100

Sources: *Quadros de Pessoal* and authors' calculations.

Note: ISIC refers to the International Standard Industrial Classification of All Economic Activities.

Chart 7

MAIN SECTORS OF IMMIGRANT EMPLOYMENT IN PORTUGAL	
Immigrants, shares in total	**Natives, shares in total**

Sources: *Quadros de Pessoal* and authors' calculations.

Table 6

EDUCATION ATTAINMENT OF NATIVE AND IMMIGRANT EMPLOYEES IN PORTUGAL, AVERAGE 2002-2008 | SHARES, PER CENT								
	Natives	**Immigrants**						
			EU15	***PALOP***		**CEEC**		**Brazil**	**China**
					Cape Verde		**Ukraine**		
Very low	46.9	44.1	19.5	55.8	71.3	43.8	45.1	37.0	70.0
of which: illiterate	1.2	4.1	0.5	4.9	8.7	6.3	6.7	1.7	15.3
Low	21.4	24.2	19.7	21.7	16.4	26.8	26.7	27.9	20.1
Medium	20.2	23.1	29.8	16.7	10.0	23.6	22.6	29.5	7.2
High	11.5	8.7	31.0	5.9	2.3	5.8	5.6	5.7	2.7
	100	100	100	100	100	100	100	100	100

Sources: *Quadros de Pessoal* and authors' calculations.
Note: Very low education level refers to ISCED 0-1 (primary, up to 6 years), low refers to ISCED 2 (lower secondary, up to 9 years), medium refers to ISCED 3-4 (upper-secondary, up to 12 years) and high refers to ISCED 5-6 (tertiary).

education in the 2002-2008 period. These education levels are much lower than in the case of immigrants from other *PALOP* and are comparable to those of workers from China, even though the Chinese have a higher percentage of illiterates (15.3 per cent). The proportion of highly-educated workers is very similar in immigrants from the *PALOP*, CEEC and Brazil (between 5.7 and 5.9 per cent of total), but the Brazilians have a smaller share of individuals with very low education levels and a higher percentage of workers with medium education. In contrast, the educational attainment of immigrants from the EU15 is significantly higher than that of all other nationality groups, including the natives, with more than 30 per cent of them having tertiary education.

3. The wages of immigrants in Portugal

The wage-setting procedure in Portugal is mainly determined by three thresholds: first, the lower limit is defined, at the national level, through the legal mechanism of the minimum wage; second, nominal wage cuts in the private sector are forbidden by law (Labour code, art. 129); finally, in the context of wage bargaining, the vast majority of the lower limits of wages for each professional group are defined

by sectoral agreements, as firm agreements are the exception. Hence, there is not an automatic wage indexation mechanism. This framework is common to both native and immigrant workers.

As expected, the distribution of wages for the total economy shows a mode in wages equal to, or very close to, the minimum wage. Furthermore, looking to this distribution one can see that the concentration of immigrants in lower wages was higher (Chart 8).[4] This was true for both total employees and employees who stayed at least for two consecutive years in the same firm. As workers who entered or exited a given firm in a given year, either natives or immigrants, earned lower wages, the concentration in the bottom-end of the wage distribution was higher for total employees than for stayers.

Not controlling for any differentiating factors, immigrants in Portugal are, on average, paid below the wages of native workers over the 2002-2008 period (Chart 9). In addition, the proportion of workers that are paid below the minimum wage is substantially higher for immigrants than for natives. In 2002, the average wages of native workers were 18.2 per cent above the average wages of immigrants, but this wage gap decreased to 13.3 per cent in 2008. Having started from lower wage levels, the average growth of wages in the period 2002-2008 was higher for immigrants than natives (annual average change of 4.4 and 3.7 per cent, respectively).

There are also important differences in average wages within immigrant workers in Portugal (Chart 10). Over the period analysed, the average wage of workers from the EU15 was almost twice as high as the average wage of natives and immigrants as a whole, growing at an annual rate of change of 4.6 per cent.[5] Immigrants from the *PALOP* earn less than the average immigrant but the difference is particularly stark in the case of workers from Cape Verde, which earn on average about 15 per cent less than the average *PALOP* worker. In 2002, the average wage of CEEC immigrants was lower than the one of

Chart 8

| DISTRIBUTION OF WAGES IN PORTUGAL, 2008	
Total	**Stayers**

Natives   Immigrants
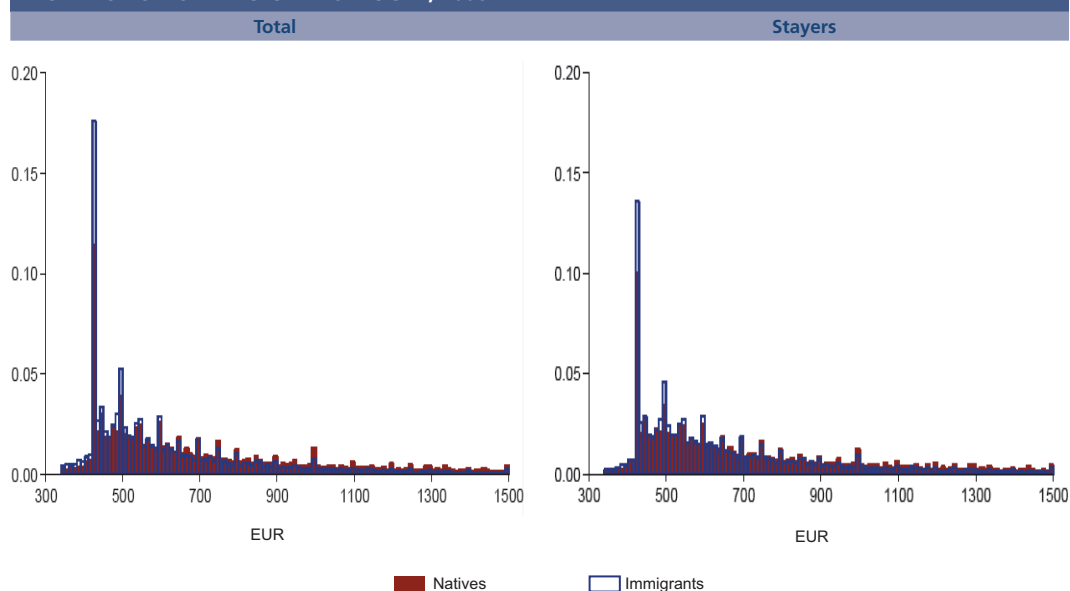
Sources: *Quadros de Pessoal* and authors' calculations.
Note: Stayers only include employees who stayed for at least two consecutive years in the same firm.

4   The distributions of wages are similar throughout the period analysed. These distributions are available from the authors upon request.
5   As wage distributions exhibit a higher concentration in the left tail, the average wage is higher than the median wage. However, the results remain qualitatively unchanged if the median was used instead.

Chart 9

WAGE LEVELS OF NATIVE AND IMMIGRANT EMPLOYEES IN PORTUGAL

Chart 10

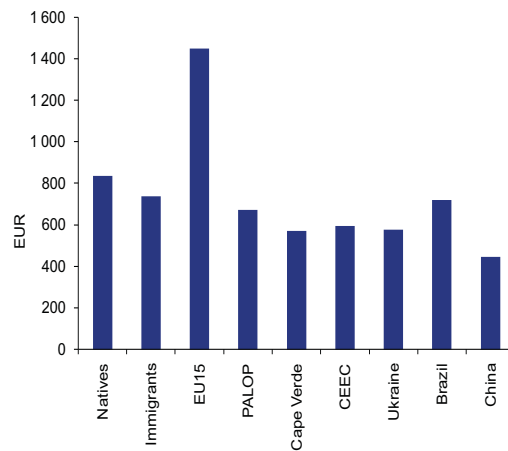**WAGE LEVELS BY MAIN NATIONALITIES, AVERAGE 2002-2008**
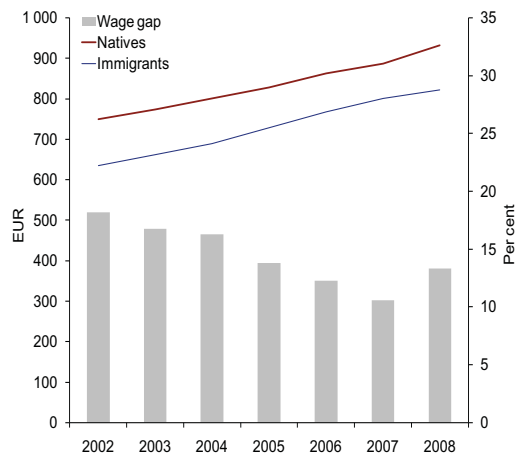
Sources: *Quadros de Pessoal* and authors' calculations.

Note: The percentual wage gap is defined as the difference between the average wages of native and immigrant workers expressed as a percentage of natives wages.
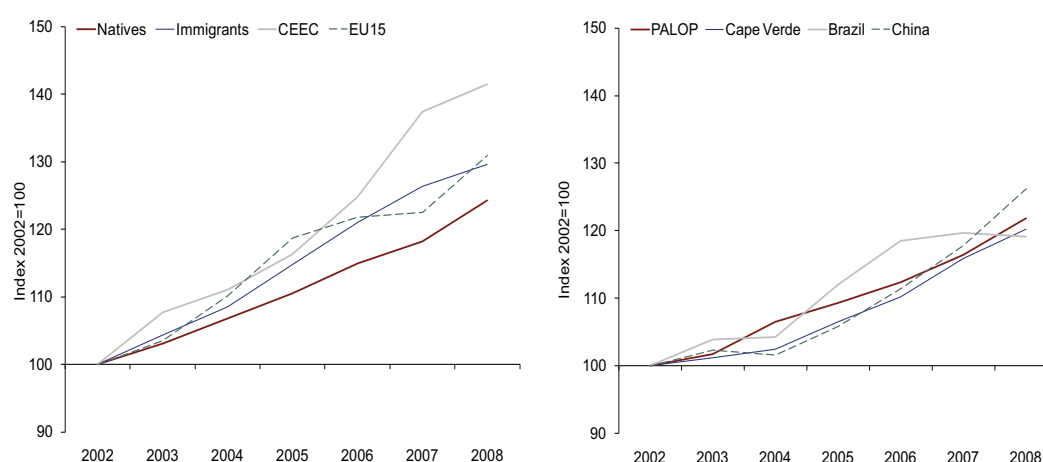
Sources: *Quadros de Pessoal* and authors' calculations.

workers from Cape Verde. However, the wages of CEEC workers grew significantly from 2002 to 2008 (41.4 per cent over the whole period, *i.e.*, an annual change of 5.9 per cent) (Chart 11). The average wage of Brazilian workers in 2002 was similar to the average wage of immigrants as a whole. However, particularly in the last few years, the rate of change of wages of Brazilian workers was the lowest of all migrant groups considered, being slightly negative in 2008. Chinese immigrants earn wages significantly lower than other migrant groups, on average, reflecting their strong concentration in some low-skilled sectors, like wholesale and retail trade, and hotels and restaurants, and also the extremely high share of minimum wage earners, which we will examine in more detail below. Nevertheless, the high percentage of minimum wage earners may be one of the reasons why the wages of Chinese workers increased at a higher pace than total immigrants' wages in the last two years. Summing up, apart from EU15 workers, the other migrant groups earn lower wages than natives, and the higher average wage growth of immigrants compared to natives over the period analysed was mainly driven by developments in the wages of CEEC workers, whose tenure also rose steadily, and, to a lesser extent, of workers from the EU15.

Several factors may contribute to the wage gap between natives and immigrants observed throughout the 2002-2008 period. This gap is linked with a broad range of variables that can have an impact on wages, such as age, gender, education, type of contract, tenure, sector and region, as we will discuss in further detail below. However, these variables do not seem to fully explain the observed wage gap between native and immigrant workers. For the whole sample period, we estimated a simple wage regression including variables controlling for the age, gender, education, type of contract, tenure, sector and region, and also nationality and time dummies. The results in table 7 show that the wage gap between natives and immigrants persists even after taking into account these regressors (OECD (2008) found a similar result using data for 2005). From about 15 per cent, the average wage gap between natives and immigrants as a whole remains at 8.5 per cent even after controlling for worker, firm and match characteristics. Within immigrants, these characteristics account for around 40 and 30 per cent of the negative wage gap for *PALOP* and CEEC immigrants, respectively. This percentage is significantly higher in the case of Brazilians (almost 60 per cent) and Chinese workers (about 70 per cent). About half of the positive gap between the wages of EU15 and native workers is related with the selected regressors.

Chart 11

EVOLUTION OF AVERAGE WAGES BY MAIN NATIONALITIES | CUMULATIVE GROWTH

Sources: *Quadros de Pessoal* and authors' calculations.

Table 7

LOG WAGES FOR IMMIGRANTS COMPARED TO THE NATIVES, AVERAGE 2002-2008								
	Immigrants							
		EU15	*PALOP*		CEEC		Brazil	China
				Cape Verde		Ukraine		
Coefficient of the nationality dummy								
Without controls	-0.149	0.329	-0.176	-0.265	-0.239	-0.251	-0.190	-0.484
With controls	-0.085	0.156	-0.106	-0.117	-0.164	-0.179	-0.077	-0.149
Explained gap (% of total gap)	42.9	52.6	39.5	56.0	31.7	28.6	59.3	69.2

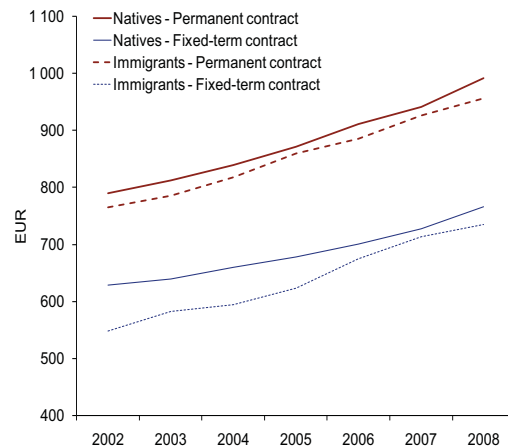**Sources:** *Quadros de Pessoal* and authors' calculations.

Note: All regressions include time dummies. The control variables are age, gender, education, region, sector, tenure and type of contract.

Apart from information on tenure, our regression does not control for the duration of stay of immigrants in Portugal. Among other factors, longer periods of residence are associated with better language skills and more experience acquired in the destination country, which can contribute to partly offset the remaining wage gap between natives and immigrants (see, for instance, Carneiro *et al.* (2010)). A more in-depth analysis of the process of economic assimilation of immigrants in Portugal is an interesting topic for future research.

Worker, firm and match characteristics included in the wage regression presented above account for around 40 per cent of the overall wage gap between natives and immigrants. In the following analysis, we will examine some of these variables in more detail. Regarding the type of contract, results from the regression presented above point to the existence of a 3.7 per cent penalty on wages of similar workers but with fixed-term contracts. In the period 2002-2008, the positive wage gap between natives and immigrants is common to workers with permanent and fixed-term contracts (Chart 12). Considering workers with permanent contracts, the wage gap between natives and immigrants remained almost stable over this period, while the difference in wage levels of natives and immigrants with fixed-term contracts declined from 2002 to 2008. Moreover, workers with permanent contracts earn higher average wages than those with fixed-term contracts, both in native and in immigrant employment. In the period 2002-2008, natives with permanent contract earned approximately 27 per cent more than natives with fixed-term contract. In the case of immigrants this percentage gap was even higher, reaching 34 per

Chart 12

WAGE GAP BETWEEN NATIVES AND IMMIGRANTS IN PORTUGAL BY TYPE OF CONTRACT

Sources: *Quadros de Pessoal* and authors' calculations.

cent. Throughout the period, the difference in wage gaps between permanent and fixed-term contracts - of native and immigrant workers - dwindled away, being very similar in the most recent period (about 30 per cent). Hence, as the percentage of native workers with permanent contracts is higher than for immigrants and higher than the percentage of natives with fixed-term contracts, the wage gap between permanent and fixed-term contracts contributed positively to the higher average wages of natives when compared to immigrants.

The pattern of differences in wage levels between natives and immigrants does not change substantially across the main sectors of activity of immigrant employment. Apart from EU15 workers, immigrants have lower average wages than natives in construction, hotels and restaurants, real estate and business services, and wholesale and retail trade. Nevertheless, there are some differences in the evolution of average wages of natives and immigrants over time in these sectors.

In wholesale and retail trade, the wages of immigrant workers increased at a lower rate than the wages of natives (annual rates of 2.6 and 3.6 per cent, respectively) (Table 8). On the one hand, the wages of Brazilian (the most significant group of immigrants in this sector), CEEC and Chinese workers increased at a higher pace than the wages of natives. On the other hand, changes in the wages of *PALOP* workers were below those of natives. Furthermore, the wages of workers from the EU15 decreased significantly in 2007 and 2008. Given the higher level of their wages, this evolution in wages of EU15 workers had a strong negative contribution to the developments in total immigrants' wages.

In contrast, in the construction sector, immigrants' wages grew more than those of native workers from 2002 to 2008 (annual average rates of 5.8 and 4.8 per cent, respectively). Wages from *PALOP* workers increased almost the same as natives, but the average wages of CEEC workers - the other dominant group of immigrants in the construction sector - grew significantly (54.2 per cent in cumulative terms, *i.e.*, an annual rate of change of 7.5 per cent). In spite of having started at a similar point in 2002, the wages of workers from Cape Verde in the construction sector increased by far less than overall *PALOP* workers, resulting in a gap in average wage of about 70 euros in 2008.

In the real estate and business services, workers from Cape Verde also earned lower wages, on average, over this period. Yet, the developments in their wages were significant, with an average wage growth higher than for total immigrants and natives working in this sector. Immigrants from other *PALOP* had feeble wage developments, as the cumulative average wage growth of total *PALOP* workers in this

Table 8

EVOLUTION OF AVERAGE WAGES BY MAIN NATIONALITIES AND SECTORS OF ACTIVITY OF IMMIGRANT EMPLOYMENT	ANNUAL AVERAGE RATE OF CHANGE OVER THE PERIOD 2002-2008, PER CENT								
		Natives	Immigrants						
				EU15	*PALOP*		CEEC		Brazil	China
ISIC code						Cape Verde		Ukraine		
45	Construction	4.8	5.8	2.8	4.9	2.9	7.5	7.4	2.7	-6.1
50-52	Wholesale and retail trade	3.6	2.6	2.4	3.1	3.2	4.7	4.5	4.0	4.2
55	Hotels and restaurants	3.9	3.8	4.2	3.3	3.6	4.7	5.0	4.1	3.7
70-74	Real estate and business services	2.1	2.1	2.1	1.4	2.8	5.0	5.3	0.6	4.8
	Total	3.7	4.4	4.6	3.3	3.1	5.9	6.4	3.0	4.0

Sources: *Quadros de Pessoal* and authors' calculations.

sector was about 4 percentage points below natives in the period 2002-2008. The average wage of Brazilians increased only by 3.7 per cent in 6 years, *i.e.*, an annual change of 0.6 per cent, with negative rates of change in 2007 and 2008. So, in spite of the sharp increase in the average wages earned by CEEC workers, the wages of total immigrants grew virtually the same as those of natives in this sector.

In hotels and restaurants, the wages of immigrants and natives also increased roughly the same over this period, with an annual average rate of change of around 4 per cent. Wages of CEEC and Brazilian immigrants grew above average over this period, while the wages of *PALOP* workers increased by 3.3 per cent on average each year. Chinese workers in this sector have a cumulative wage growth close to the average over the period, but show a strong wage increase in the last two years, in line with the higher incidence of minimum wage earners in Chinese immigrants.

Indeed, the percentage of minimum wage earners is higher for immigrants than natives. In the period from 2002 to 2008, 12.5 per cent of workers reported wages close to the minimum wage (interval of +/- 10 euros centered on the minimum wage). Over this period, 12.1 per cent of native workers earned the minimum wage, while in the case of immigrants, the proportion of minimum wage earners reached 18.6 per cent, on average. After a period where it remained fairly stable, the percentage of minimum wage earners grew for natives and, even more markedly, for immigrant workers in 2007 and 2008, amidst significant increases of the legal minimum wage of 4.4 and 5.7 per cent, respectively (Chart 13).

Immigrants from the EU15 have the lowest share of minimum wage earners, even lower than that of natives. In contrast, approximately every two out of three Chinese workers are reported as earning the minimum wage in this period. Minimum wage earners account for 14.3 per cent of total immigrants from *PALOP* but that proportion reaches 15.6 per cent if we consider workers from Cape Verde only. Immigrants from the CEEC and from Brazil have an average percentage of minimum wage earners of 20.5 and 22.3 per cent, respectively, over the period 2002-2008. In the case of immigrants from Brazil that share increased strongly in the last two years to 28.8 per cent in 2008, while in the case of the CEEC it remained mostly stable around 20 per cent.

The shapes of the distributions of wages across different education levels were broadly similar to the distributions for total workers. Again, immigrants tended to be more concentrated on lower wages. Without controlling for factors other than education, the wage gap between natives and immigrants was positive, rising steadily from the bottom to the top of the wage distribution (Chart 14).[6] The gap is minimum at the very bottom of the wage distribution. As pointed out by Carneiro *et al*. (2010), the

[6] Information displayed on chart 14 refers to 2008. The results are qualitatively similar throughout the period analysed and are available from the authors upon request.

Chart 13

**PERCENTAGE OF WORKERS EARNING THE MINIMUM WAGE**

| Annual shares | By nationalities, average 2002-2008 |
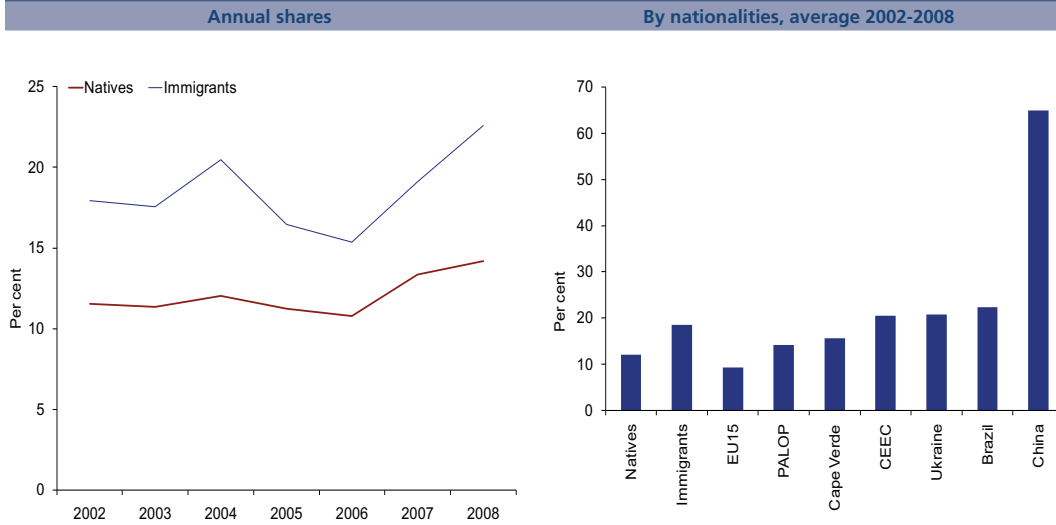
Sources: *Quadros de Pessoal* and authors' calculations.

Note: Consider as workers earning the minimum wage all those workers whose wage lies in an interval of ±10 euros centered on the minimum wage.

Chart 14

WAGE GAP BETWEEN NATIVE AND IMMIGRANT EMPLOYEES IN PORTUGAL, 2008

| Overall gap | By education level (years completed) |
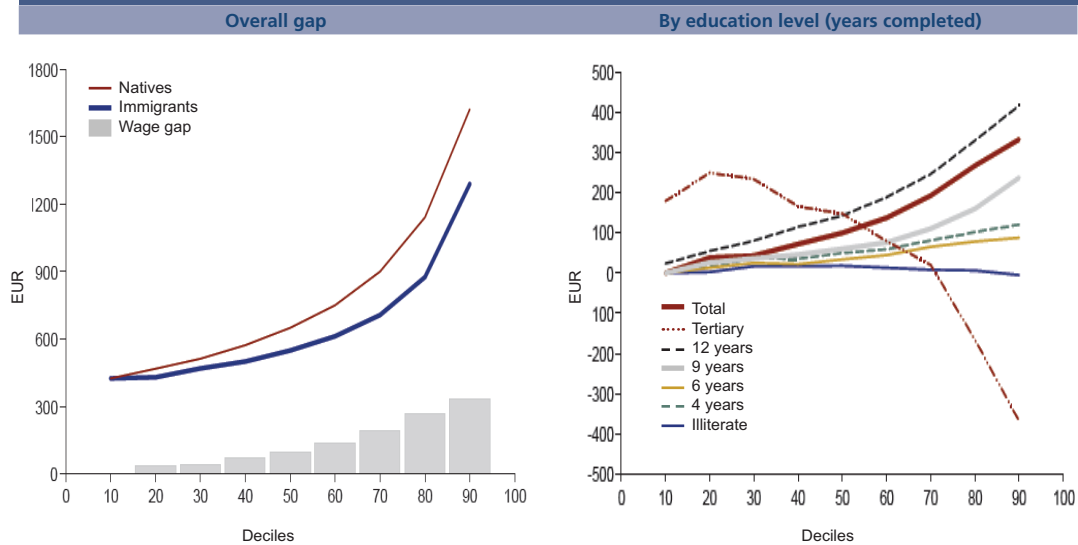
Sources: *Quadros de Pessoal* and authors' calculations.

existence of a mandatory minimum wage level may act as a forceful instrument to limit the wage gap between native and immigrant workers at the bottom-end of the wage distribution.

There are two interesting exceptions to this scenario. First, the wage gap between immigrants and natives was virtually nil in the case of illiterate workers. Within these workers, Ukraine and Cape Verde are the most important origin countries. The second refers to the group of workers in the top-end of the education distribution (tertiary education level), which in the case of immigrants are mostly from the EU15, namely Spain and France. In this case, immigrants were more concentrated on both tails of

the wage distribution, *i.e.*, very low and very high wages. In the left tail of the wage distribution the wage gap was again positive, *i.e.*, wages of immigrants were lower. Nevertheless, as one moves to the right, the positive wage gap progressively diminishes, reversing its sign as one approaches the top-end of the wage distribution. Thus, for example in 2008, immigrant workers with tertiary education and on the top 30 per cent of wage distribution were better paid than native workers with tertiary education on the top 30 per cent of wage distribution.

Regarding the distribution of wage changes, negative nominal changes almost do not exist (Chart 15).[7] Moreover, there is very high concentration on the zero change, which can be interpreted as a sign of downward nominal wage rigidity and this feature is, in general, slightly higher in the case of immigrant workers.[8] Between 2003 and 2006 the distribution of wage changes had a second mode near the expected inflation rate, bargaining and minimum wage reference value (evidence in favour of a mix of downward real and institutional wage rigidity), common to both natives and immigrants. In 2007 and 2008, the distribution of wage changes has three spikes - at zero, at the expected inflation rate value (and bargaining reference value) and at the rate of change of the minimum wage. The concentration in the rate of change of the minimum wage is higher for immigrant workers, reflecting the higher percentage of immigrants earning the minimum wage. Despite differences in the relative size of the spikes, the main features of the distribution of wage changes - near absence of negative changes and two- or three-spike distributions - were common to immigrants across nationalities, education levels and activity sectors.[9]

Chart 15

DISTRIBUTION OF WAGE CHANGES IN PORTUGAL

2003 | 2008

Per cent

■ Natives   □ Immigrants
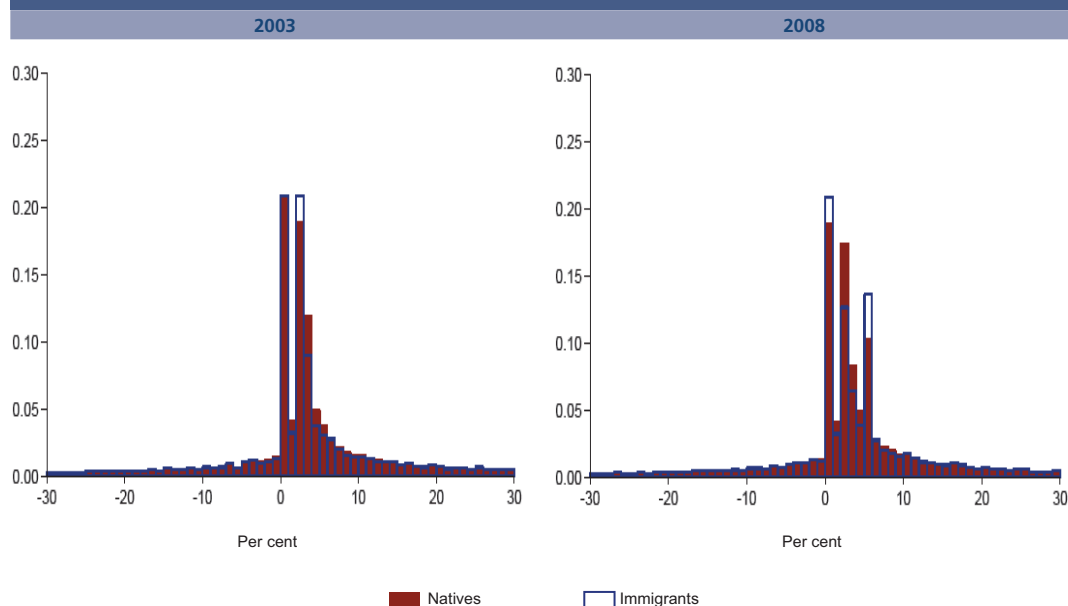
Sources: *Quadros de Pessoal* and authors' calculations.

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7 Since wage changes were calculated at the individual level, this distribution only includes employees who stayed for at least two consecutive years in the same firm.
8 Cabral and Duarte (2010) computed measures of nominal and real downward wage rigidity using the International Wage Flexibility Project (IWFP) methodology and found evidence that wage rigidity is slightly higher for immigrants than for Portuguese workers in the 2003-2008 period.
9 All distributions are available from the authors upon request.

4. Conclusions

Historically, Portugal has been a country of emigration, but in the late nineties immigration flows grew strongly driven by high labour demand. A significant share of this new immigration flows came from Central and Eastern European countries (CEEC), *i.e.*, from countries with no evident cultural link with Portugal. More recently, there was a very significant increase in the arrivals of immigrants from Brazil. Immigration from China, although growing strongly in the last decade, still represents a small percentage of total immigrant workers. At present, three major groups make up the bulk of immigration in Portugal, representing around 75 per cent of total: Brazil, Portuguese speaking countries in Africa (*PALOP*) and CEEC. The increase in immigration flows and the substantial change in its composition makes it relevant to describe and analyse the characteristics of immigrant workers in Portugal, especially given that empirical evidence about immigration in the Portuguese labour market is still relatively scarce.

In this article, we used a longitudinal matched employer-employee database (*Quadros de Pessoal*) to examine the main characteristics of immigrants in the Portuguese labour market in the 2002-2008 period. We found substantial differences in labour market outcomes between native and immigrant workers and among different nationality groups, in terms of age, gender, tenure, worker flows, geographical and sectoral concentration and education levels. Given the recent nature of most immigrant flows in Portugal and the much higher incidence of fixed-term contracts among immigrants, their tenure is, on average, significantly lower than that of natives. In addition, worker rotation rates are higher for immigrants than for natives. Immigrant workers in Portugal are mostly concentrated in four sectors of activity, construction, hotels and restaurants, real estate and business services, and wholesale and retail trade.

Similarly to other countries, immigrants in Portugal are, on average, paid below the wages of native workers. Moreover, the percentage of minimum wage earners is higher for immigrants than natives. The differences between native and immigrant workers in terms of age, gender, education, type of contract, tenure, region and sector, contribute to the positive gap between the wages of native and immigrant workers. However, these variables do not seem to fully explain the observed wage gap between native and immigrant workers. The average difference between the wages of native and immigrant workers decreased throughout the period 2002-2008, as the cumulative growth of wages in this period was higher for immigrants than natives.

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