Fiscal Austerity, Unemployment and Family firms

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Abstract

I calculate unemployment multipliers of fiscal consolidation policies in a New-Keynesian model with search and matching frictions and, as a novelty, firm heterogeneity. Family and non-family firms are distinguished, focusing on the different labor market behavior and the different way of management of family firms. This latter is modeled by including intangible capital in the family sector. The model is calibrated to match European data on countries with a high share of family firms in the labor force. I find that fiscal austerity raises unemployment. Both at peak and cumulatively, unemployment reacts least when the budget is consolidated by increasing the value added tax rate. At peak, the highest increase in unemployment is implied by a government consumption cut, while a labor income tax hike induces a more prolonged unemployment reaction. At the same time, the only policy which results in a welfare is a cut in government consumption. The role of firm heterogeneity is crucial as the magnitude of the unemployment multipliers is very different without that.

Keywords: Fiscal austerity, Tax Policy, Unemployment multiplier, Firm heterogeneity, Family firms, Intangible capital


1 Introduction

1.1 Unemployment multiplier literature

One of the early examples of the unemployment multiplier literature is Monacelli et al (2010). They find that a 1 per cent of GDP government consumption increase decreases unemployment by 0.6 percentage points at peak\(^2\), although their theoretical multiplier based on a New-Keynesian model produces a much lower multiplier, about 0.2 percentage points. On the contrary, Bruckner-Pappa (2012) suggest that a loosening fiscal policy implies a rise in unemployment\(^3\). They also present a model with price rigidity, labor force participation, and short and long-term unemployment which enables them to reproduce their empirical findings\(^4\).

The beforementioned studies rely on aggregate government expenditure data. The narrative approach achieves identification using historical records of the policy decision making process. Two examples are Guajardo et al (2011) and Ball et al (2013), both suggest that fiscal tightening increases unemployment\(^5\).

The above papers concentrate on government consumption, however, other fiscal instruments might imply different effects. Bermperoglou et al (2013) estimate the impacts of several expenditure-based fiscal austerity policies, and find that a 1 per cent of GDP decrease in government consumption, investment and vacancies increase unemployment by 0.77, 0.78 and 1.79 percentage points, while a 1 per cent of GDP decrease in public wages reduces unemployment by 0.12 percentage points\(^6\). A New Keynesian model with labor force participation and public employment provides similar theoretical responses. Also, Dallari (2014) shows empirical evidence that a cut in government investment might increase or might decrease unemployment, depending on the country in question\(^7\).

Thus, on the whole, there is no consensus in the literature, neither as regards the sign, nor concerning the magnitude of the unemployment multipliers. Besides, I am not aware of any - either empirical or theoretical - unemployment multipliers of revenue-based fiscal policies\(^8\). Not to mention firm heterogeneity, which was not studied in the unemployment multiplier literature before\(^9\).

\(^2\)Based on a VAR on US data.
\(^3\)A 10 per cent increase in government consumption results in a 0.2-0.5 percentage points increase in unemployment at peak by estimating structural VARs of several OECD countries.
\(^4\)Another example is Dallari (2014) who claims that the impact multipliers of a government consumption cut vary from −4.5 to 8.7, using a panel structural VAR of European countries.
\(^5\)Both papers use a sample of OECD countries. Guajardo et al (2011) claim that two years after the shock a 1 per cent of GDP fiscal consolidation implies a 0.32 percentage points increase in unemployment, while Ball et al (2013) find that fiscal consolidation implies an increase in long-term unemployment of about 0.5 percentage points in the medium term.
\(^6\)Based on a SVAR with sign restrictions of the US.
\(^7\)Impact multipliers of a government investment cut vary from −1.72 to 4.13 in Europe.
\(^8\)Ball et al (2013) claim that spending-based adjustments have a more pronounced effect than tax-based adjustments, but due to the fact that they consider a narrative approach, they are only able to compare fiscal consolidations on the whole without specifying the policies themselves.
\(^9\)Workers’ heterogeneity is not considered either, except Bruckner-Pappa (2012) who introduced short and long term unemployment in their framework.
1.2 Data and literature on family firms

A family firm is a firm owned and/or managed by a family. As Anderson-Reeb (2003) define, a family firm is a firm where the fraction of equity owned by - founding - family is above a threshold or family members are present on the board of directors.

As Table 1 shows, almost every second worker in Europe is employed by a family firm. In some countries family firms are more relevant than in others, employing 54.6 and 35.2 per cents of the labor force, respectively.11

<table>
<thead>
<tr>
<th>Share of family firms in workforce (%)</th>
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<tr>
<td>Countries above average</td>
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<tr>
<td>Austria</td>
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<td>Estonia</td>
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<td>France</td>
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<td>Italy</td>
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<td>Spain</td>
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Average 56.4 % | Average 33.9 %
Average 46.2 %

Table 1: Family firms and the European labor force

In addition, the level of unemployment is on average lower in countries where family firms are less present (Table 2), 5.0 per cent compared to 8.1 per cent otherwise.13

Even though their share is remarkable, family firms have not been in the focus of macroeconomic research yet.14 At the same time, many of their characteristics have been documented in the corporate finance literature, based on empirical firm level evidence.

11The share of family firms is even higher in the number of firms, see e.g. among others La Porta et al (1999) and Mandl (2008).
13Own calculation based on Eurostat data between 2000 and 2012.
14Regarding the macroeconomic relevance of family firms, I am only aware of one paper, Caselli-Gennaioli (2013). Based on a simple growth model, they claim that family management happens because of poorly functioning financial markets, this and the fact that family managers are less talented show that the share of family firms is important in explaining cross-country income differences. However, they do not talk about the labor market. Recently, Epstein-Shapiro (2014) study labor market policies in a model with firm heterogeneity, however, they do not consider fiscal consolidation policies, and they only focus on firm size without discussing other firm characteristics.
First, family firms behave differently in the labor market compared to non-family firms. On the one hand, job security is higher among family firms, namely, the dismissal rate of workers is lower (Sraer-Thesmar, 2007 and Bassanini et al., 2011). On the other hand, workers of family firms obtain a lower wage and their bargaining power in wage setting is also lower (Bassanini et al., 2011). Still, they are more loyal (Siebert et al., 2011) to their employers.

Second, as Caselli-Gennaioli (2014) point out, dynastic management, "the inter-generational transmission of managerial responsibilities", is crucial for family firms. The current owner/manager ("the son") of the firm inherits a managerial know-how - related to customers, suppliers and other market operators - from the previous owner/manager ("the father"). Or, to put it otherwise, the decision or investment horizon of family firms is longer (they discount the future less).

There is no consensus in the literature though, whether family firms are more or less productive than non-family firms. Bennedsen et al. (2007) claim that family management has a negative impact on firm performance. However, Maury (2006) and others, e.g. Anderson-Reeb (2003), Villalonga-Amit (2006) or King-Santor (2007), find that the relationship between family management and firm performance is not monotonic.

A general misunderstanding about family firms is that all family firms are small. As Mandl (2008) highlights the family business sector is mainly dominated by small and medium-sized companies. However, some of the largest firms are also family firms, for example, Volkswagen, Metro or Bosch. Also, as IFERA (2003) claims, not only Wal-Mart, one of the largest companies of the world, is a family company,

Furthermore, not only job security in family firms is higher, but these firms are less likely to exit the market (Nunes et al., 2014).

http://www.campdenfb.com/article/top-100-family-businesses-europe-1

<table>
<thead>
<tr>
<th>Countries with above average</th>
<th>Countries with below average</th>
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<tr>
<td>family firm share in labor force</td>
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<tr>
<td>Austria 3.7</td>
<td>Finland 6.6</td>
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<tr>
<td>Estonia 9.1</td>
<td>Netherlands 3.3</td>
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<tr>
<td>France 7.7</td>
<td>Norway 2.5</td>
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<tr>
<td>Germany 8.0</td>
<td>Romania 5.4</td>
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<tr>
<td>Hungary 6.9</td>
<td>Slovenia 5.5</td>
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<tr>
<td>Ireland 7.5</td>
<td>Sweden 7.0</td>
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<tr>
<td>Italy 8.2</td>
<td>UK 4.3</td>
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<td>Spain 13.7</td>
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Table 2: Unemployment by share of family firms in European labor force

Average 8.1% Average 5.0% Average 6.6%
but further 37 per cent of the Fortune 500 companies are family firms. Figure 1 shows an overview of the size structure of European firms.

Figure 1: Size structure of family firms in Europe (Mandl, 2008, page 50)

Considering employment or turnover, the dominance of small firms is even less significant among family firms. According to Mandl (2008), the share of family firms with annual turnover more than 50 million EUR is 34 per cent in Germany. Also, in Ireland 27.1 per cent and in Finland 22 per cent of large firms are family firms. In the UK, the share of large firms in the family sector is lower, 15.6 per cent, but still remarkable (IFB, 2011). In Italy, the average number of employed people is 68 in the family sector and 305 in the non-family sector, based on Navaretti et al (2008).

Another common misinterpretation is that family firms are not export-oriented, but this contradicts the empirical evidence. According to IFB (2011), in the UK, 19 per cent of family firms sold export last year, while the relevant non-family value is lower, 15 per cent. In Italy, share of family firms which do not export is only slightly higher than that of the non-family sector, 34.3 and 23.8 per cents, respectively (Navaretti et al, 2008). Regarding Spain, both the export propensities and the export intensities of family and non-family firms are very similar (71.1 and 68.8, and 20.9 and 25.3 per cents, respectively), shown by Merino et al (2012). Similar conclusion can be made for Italy (Minetti et al, 2013.).
1.3 Outline of the paper

As described above, the evidence about unemployment multipliers, concerning both their sign and their magnitude, is somewhat mixed in the literature. Moreover, most papers focus on expenditure-based policies only, and firm heterogeneity was not considered yet. Thus, the purpose of this paper is to estimate unemployment multipliers of expenditure and revenue-based fiscal consolidation policies in the presence of firm heterogeneity.

In particular, I develop a model, based on a standard New Keynesian framework with search and matching frictions, and with family and non-family firms. On the one hand, I focus on the different labor market behavior of family firms, on the other hand, introducing an organisational capital in the family sector enables me to model the dynastic management of family firms. This organisational capital is modeled as an intangible capital, following Danthine-Jin (2007). For the purpose of illustration, the model is calibrated to match the average unemployment level and family firm employment share of those countries where family firms are more than on average present in the labor market.

My model predicts that fiscal austerity raises unemployment. At peak, the highest increase in unemployment is implied by a cut in government consumption. Nevertheless, the fiscal instrument producing the highest cumulative multiplier depends on the time horizon considered. At the same time, both at peak and cumulatively, unemployment reacts least when the budget is consolidated by increasing the value added tax rate. Hence, my results suggest that consolidating the budget is the least costly, in terms of employment, when it happens by raising the value added tax rate. However, there are trade-offs, namely, the welfare of agents considerably goes down after a tax hike, while it goes up when the budget is consolidated on the expenditure side. Firm heterogeneity is crucial, unemployment multipliers with and without heterogeneity are very different.

The structure of the paper is as follows. The next Section describes the model, while its calibration is presented in Section 3. Results appear in Section 4. Section 5 concludes, while the Appendix provides more detail on baseline impulse response functions and the sensitivity of the results. A separate Technical Appendix summarises the steady state and loglinearised equations.

2 Modeling framework

My model builds on a dynamic stochastic general equilibrium (DSGE) framework with price stickiness (Rotemberg, 1982). Additionally, there is unemployment due to search and matching frictions (Gertler et al, 2008 and Stahler-Thomas, 2012).

Moreover, there is firm heterogeneity, i.e. family and non-family firms are distinguished. On the one hand, in the labor market, family firms behave differently than non-family firms by providing higher job security but lower wages and lower bargaining power to workers. On the other hand, the dynastic management of family firms is modeled by an intangible capital a la Danthine-Jin (2007).

2.1 Representative household

There is a representative household which maximizes expected discounted lifetime utility:

\[ E_0 \sum_{t=0}^{\infty} \beta^t u(C_t) \]

Here, \( \beta \) is the usual discount factor. For simplicity, I assume that the household only derives utility from aggregate consumption \( C_t \). \(^{18}\)

The household’s contemporaneous utility is:

\[ u(C_t) = \frac{(C_t - hC_{t-1})^{1-\sigma_C} - 1}{1 - \sigma_C} \]

where \( h \) is external habit parameter to smooth consumption, and \( \sigma_C \) is the relative risk aversion parameter.

There is unemployment in the labor market due to search and matching frictions. A member of the household might work in the intermediate family sector \( (L_{F,t}) \) or in the intermediate non-family sector \( (L_{NF,t}) \). If the household member is not employed in any of these sectors, she is unemployed. I define the beginning of period unemployment by \( U_t \):

\[ U_t = 1 - L_{F,t-1} - L_{NF,t-1} \]

Here, I normalise the total number of labor force to one, so I do not take into account labor force participation decision. \(^{19}\)

When working in the family or in the non-family sector, the household receives labor income, \( W_{F,t} \) and \( W_{NF,t} \), respectively. These are sectoral real wages, expressed in the economy-wide price level \( P_t \). Labor income is taxed in both sectors by \( \tau_{L,t} \), which is the sum of personal income tax and employers’ and employees’ social security contributions. Even though social security contributions are deducted from labor income, modeling retirement is beyond the scope of this paper. When begin unemployed, the household member receives \( W_U \) unemployment benefit, also expressed in economy-wide price level.

\(^{18}\)See e.g. Gertler et al (2008).

\(^{19}\)A recent example of a model with labor force participation is Bermperoglou et al (2013).
The household owns and rents physical capital to intermediate family and non-family firms, $K_{F,t}$ and $K_{NF,t}$, so she receives rental rate of capital, $RK_{F,t}$ and $RK_{NF,t}$, respectively. The rental rates differ in the two sector, and are expressed in terms of the economy-wide price level like wages. The household can save either in a risk free government bond $B_t$, after which she gets $i_{t-1}$ nominal interest rate, deflated by $\pi_t$ quarterly inflation rate, or she can invest into physical capital. To avoid jumps in invesment, it is subject to investment adjustment cost following Christiano et al (2005):

$$K_{F,t} = (1 - \delta_F)K_{F,t-1} + I_{F,t} - \frac{\phi^F}{2} \left( \frac{I_{F,t}}{I_{F,t-1}} - 1 \right)^2 I_{F,t}$$

$$K_{NF,t} = (1 - \delta_{NF})K_{NF,t-1} + I_{NF,t} - \frac{\phi^{INF}}{2} \left( \frac{I_{NF,t}}{I_{NF,t-1}} - 1 \right)^2 I_{NF,t}$$

Here, $I_{F,t}$ ($I_{NF,t}$) denotes investment into family (non-family) physical capital, $\delta_F$ ($\delta_{NF}$) is the depreciation rate of family (non-family) physical capital, and $\phi^F$ ($\phi^{INF}$) is the investment adjustment cost parameter related to family (non-family) physical capital. Investment adjustment costs are zero in steady state.

Because the household owns the firms, the household receives the dividends of intermediate and final family and non-family firms ($\text{Prof}^I_{F,t}$, $\text{Prof}^I_{NF,t}$, $\text{Prof}^F_{F,t}$ and $\text{Prof}^F_{NF,t}$, all expressed in $P_t$). The household consumes an aggregate consumption boundle $C_t$ described soon in more detail, and beside labor income taxes she must pay a value added tax $\tau_{C,t}$ related to aggregate consumption and a lump sum tax $T_t$ to close the model. For simplicity, I assume that income related to bonds or physical capital renting are not taxed.

The period-by-period household budget constraint is as follows:

$$(1 - \tau_{L,t}) (W_{F,t}L_{F,t} + W_{NF,t}L_{NF,t}) + W_U(1 - L_{F,t} - L_{NF,t}) + \frac{1 + i_{t-1}}{\pi_t} B_{t-1} +$$

$$+ RK_{F,t}K_{F,t-1} + RK_{NF,t}K_{NF,t-1} + \text{Prof}^I_{F,t} + \text{Prof}^I_{NF,t} + \text{Prof}^F_{F,t} + \text{Prof}^F_{NF,t} =$$

$$= (1 + \tau_{C,t})C_t + \frac{P_{F,t}}{P_t} I_{F,t} + \frac{P_{NF,t}}{P_t} I_{NF,t} + B_t + T_t$$

Here, $P_{F,t}$ ($P_{NF,t}$) is the price level of the goods produced in the family (non-family) sector. As the budget constraint is expressed in terms of the aggregate price level $P_t$, the relative sectoral prices are considered regarding investment.

The household maximises her expected discounted lifetime utility subject to her budget constraint and the two physical capital laws of motion with respect to $B_t$, $C_t$, $I_{F,t}$, $I_{NF,t}$, $K_{F,t}$ and $K_{NF,t}$. The household takes wages and labor as given, as these are determined in the labor market when bargaining with intermediate firms.

Optimization yields the usual Euler-equation:

$$\beta \frac{1 + i_t}{\pi_{t+1}} \frac{1}{1 + \tau_{C,t+1}} = \frac{1}{1 + \tau_{C,t}} \frac{C_{t+1}}{C_t}$$

\[20\] A counterexample is e.g. Stahler-Thomas (2012).
Because there is a value added tax, the current and next period tax levels affect the intertemporal consumption choice of the household.

The family physical capital and investment decisions of the household can be expressed by two equations, a Tobin-Q and an arbitrage condition:

$$\frac{P_{F,t}}{P_t} = Q_{F,t} - Q_{F,t} \phi^{IF} \left( 3 \frac{I_{F,t}^2}{I_{F,t-1}^2} - 4 \frac{I_{F,t}}{I_{F,t-1}} + 1 \right) + Q_{F,t+1} \phi^{IF} \left( \frac{I_{F,t+1}^3}{I_{F,t}^3} - \frac{I_{F,t+1}^2}{I_{F,t}^2} \right)$$

$$\frac{1 + i_t}{\pi_{t+1}} = \frac{RK_{F,t} + (1 - \delta_F)Q_{F,t+1}}{Q_{F,t}}$$

$Q_{F,t}$ is the price level of family physical capital, related to the Lagrangian multiplier of the relevant physical capital law of motion. A Tobin-Q of a standard, one-sector model does not contain any relative prices. However, because there are two sectors here, the relative sectoral prices appear. In steady state, the price level of family physical capital equals the relative price of family goods, instead of 1 in the usual one-sector framework. Furthermore, the arbitrage condition is also affected by the sectoral physical capital price level, so in steady state the rental rate of capital is not equal to the real interest rate net depreciation rate, but it is also affected by the sectoral Tobin-Q.

Similarly, for the non-family sector:

$$\frac{P_{NF,t}}{P_t} = Q_{NF,t} - Q_{NF,t} \phi^{INF} \left( 3 \frac{I_{NF,t}^2}{I_{NF,t-1}^2} - 4 \frac{I_{NF,t}}{I_{NF,t-1}} + 1 \right) + Q_{NF,t+1} \phi^{INF} \left( \frac{I_{NF,t+1}^3}{I_{NF,t}^3} - \frac{I_{NF,t+1}^2}{I_{NF,t}^2} \right)$$

$$\frac{i_t}{\pi_{t+1}} = \frac{RK_{NF,t} + Q_{NF,t+1}(1 - \delta_{NF})}{Q_{NF,t}}$$

Finally, $I_t$ aggregate investment is defined as follows:

$$I_t = \frac{P_{F,t}}{P_t} I_{F,t} + \frac{P_{NF,t}}{P_t} I_{NF,t}$$

The household’s utility is affected by aggregate household consumption which is a composite of consumption goods produced by family and non-family firms:

$$C_t = \left[ \frac{1}{\gamma} \frac{C_{F,t}^{\eta-1}}{C_{NF,t}^{\eta}} + (1 - \gamma) \frac{C_{F,t}^{\eta-1}}{C_{NF,t}^{\eta}} \right]^{\frac{\gamma}{\eta}}$$

$\gamma$ is the share of family firm produced goods in the consumption basket, while $\eta$ is the elasticity of substitution between family firm produced and non-family firm produced goods.
The household minimizes her expenditure spent on consumption goods, taking into account the composite consumption function above. As a result, the demand functions for consumption demand for family and non-family produced goods are as follow:

\[ C_{F,t} = \gamma \left( \frac{P_{F,t}}{P_t} \right)^{-\eta} C_t \]

\[ C_{NF,t} = (1 - \gamma) \left( \frac{P_{NF,t}}{P_t} \right)^{-\eta} C_t \]

The economy wide price level \( P_t \), which is the Lagrangian multiplier of the above maximization problem, can be expressed as a composite of the sectoral price levels:

\[ P_t = \left[ \gamma P_{F,t}^{1-\eta} + (1 - \gamma) P_{NF,t}^{1-\eta} \right]^{1/(1-\eta)} \]

Finally, the stochastic discount factor is:

\[ \beta_{t,t+1} = \beta \frac{\partial u(C_{t+1})}{\partial C_t} \frac{\partial u(C_t)}{\partial u(C_t)} \]

### 2.2 Intermediate good producing firms and wage bargaining

In each sector, there is a continuum of intermediate good producing firms, which are perfectly competitive, so they take prices as given. Intermediate firms produce goods hiring labor and renting physical capital from the household. Hiring labor requires posting vacancies, which is costly and this creates a friction in the labor market and induces unemployment. Also, intermediate firms bargaining over after tax wages with workers. Modeling the labor market is similar to Gertler et al (2008) and Stahler-Thomas (2012). Family firms behave differently in the labor market than non-family firms, their dismissal rate is lower, and their workers obtain a lower wage (in steady state) and have lower bargaining power in wage setting than in the non-family sector. Also, family firms invest into a family organisational capital, which non-family firms do not do. Family organisational capital represents the dynastic management of family firms, and is modeled by an intangible capital following Danthine-Jin (2007).

The sectoral production functions are as follow:

\[ Y_{F,t} = A_{F,t} L_{F,t}^\alpha F K_{OF,t}^{1-\alpha F-\mu} K_{OF,t-1}^\mu \]

\[ Y_{NF,t} = A_{NF,t} L_{NF,t}^\alpha NF K_{OF,t-1}^{1-\alpha NF} \]

These are, for simplicity, Cobb-Douglas functions with constant returns to scale.\(^{21}\) \( \alpha_F \) and \( \alpha_{NF} \) denote labor income shares in the two sectors, respectively. In the family sector there is an additional production input, \( K_{OF,t-1} \), which is the family organisational capital. This input represents the special knowledge of the family firm, inherited from the "father" to the "son". Also, this implies that family firms discount the future less than non-family firms.

\(^{21}\)Following the intangible capital literature, e.g. McGrattan-Prescott (2010) and McGrattan-Prescott (2014) constant returns to scale means constant returns to scale in all production inputs, including the intangible capital.
Investment into family organisational capital follows a law of motion:

\[ K_{OF,t} = (1 - \delta_{OF})K_{OF,t-1} + \theta I_{OF,t} - \frac{\phi_{OF}^I}{2} \left( \frac{I_{OF,t}}{I_{OF,t-1}} - 1 \right)^2 I_{OF,t} \]

This is similar to the physical capital law of motion described before. Nevertheless, parameter \(\theta\) appears, which represents the effectiveness of family organisational investment. In the baseline scenario, this parameter is set to 1. Family organisational investment \(I_{OF,t}\) is intangible, so it is not part of the final output. This creates a trade-off, namely, investment into family organisational capital reduces goods sold today and so also profit today, but it increases family organisational capital stock in the next period, so brings about future production and increases future profit.

\[ A_{F,t} \text{ and } A_{NF,t} \text{ are exogenous productivity levels:} \]

\[
\begin{align*}
\dot{A}_{F,t} &= \rho_{AF} A_{F,t-1} + \epsilon_{AF,t} \\
\dot{A}_{NF,t} &= \rho_{ANF} A_{NF,t-1} + \epsilon_{ANF,t}
\end{align*}
\]

In the baseline case, in steady state, I assume that the sectoral productivity levels are equal.

Regarding the labor market in more detail, in each period, both family and non-family firms post vacancies, \(v^F_t\) and \(v^{NF}_t\). The number of new hires (matches), \(m^F_t\) and \(m^{NF}_t\), depend on the number of vacancies posted and the number of people searching for a job, \(U^s_t\). Searching can be described by a matching function in each sector:

\[
\begin{align*}
\dot{m}^F_t &= \sigma_{F,m}(U^s_t)^{\sigma_F}(v^F_t)^{1-\sigma_F} \\
\dot{m}^{NF}_t &= \sigma_{NF,m}(U^s_t)^{\sigma_{NF}}(v^{NF}_t)^{1-\sigma_{NF}}
\end{align*}
\]

Here, \(\sigma_{F,m}\) and \(\sigma_{NF,m}\) are matching efficiencies, while \(\sigma_F\) and \(\sigma_{NF}\) denote matching elasticities, in the two sectors, respectively.

Similarly to Stahler-Thomas (2012), but in contrary to Gertler et al (2008) I assume that the number of people searching for a job in period \(t\) equals the number of people being unemployed at the beginning of period \(t\) (\(U_t\)) plus the number of people losing their job at the beginning of period \(t\):

\[ U^s_t = U_t + (1 - \rho^F)L_{F,t-1} + (1 - \rho^{NF})L_{NF,t-1} \]

Thus firing happens at the beginning of each period, and those who are fired can immediately start to search for a new job. Firing is exogenous, the sectoral dismissal rates are \(\rho^F\) and \(\rho^{NF}\). Furthermore, everyone can search for a job in any of the sectors, not only in the sector where someone was working before.

Those who find a job in period \(t\) start to work immediately. The same assumption is made by Gertler et al (2008) and Stahler-Thomas (2012), but Bermperoglou et al (2013) assume that those who find a job in period \(t\) start to work in period \(t + 1\) only. Given the above functional forms and assumptions, the sectoral labor laws of motion are:

\[
\begin{align*}
L_{F,t} &= \rho^F L_{F,t-1} + m^F_t \\
L_{NF,t} &= \rho^{NF} L_{NF,t-1} + m^{NF}_t
\end{align*}
\]
Finally, vacancy filling and job finding probabilities are defined:

\[ q_t^F = \frac{m_t^F}{v_t^F}, \quad q_t^{NF} = \frac{m_t^{NF}}{v_t^{NF}} \]

\[ p_t^F = \frac{m_t^F}{U_t^F}, \quad p_t^{NF} = \frac{m_t^{NF}}{U_t^{NF}} \]

As I said, posting a vacancy is costly, \( \kappa^F \) and \( \kappa^{NF} \) denote per vacancy costs. Total vacancy cost is linear in the number of vacancies posted. Also, this is the only cost in my framework. In contrary, Stahler-Thomas (2012) consider a training cost besides the vacancy posting cost. Regarding the functional form, Gertler et al (2008) do not consider a linear function. This is because they assume nominal wage rigidity, which requires a quadratic function of total vacancy costs in the number of posted vacancies. Hence, as regards the form of vacancy posting cost, my framework is the closest to that of Bermperoglou et al (2013).

Profits of the intermediate firms are:

\[
Prof_{F,t}^I = MC_{F,t}Y_{F,t}^I - W_{F,t}L_{F,t} - RK_{F,t}K_{F,t-1} - \frac{\kappa^F P_{F,t}}{P_t} v_t^F - MCFtI_{OF,t} \\
Prof_{NF,t}^I = MC_{NF,t}Y_{NF,t}^I - W_{NF,t}L_{NF,t} - RK_{NF,t}K_{NF,t-1} - \frac{\kappa^{NF} P_{NF,t}}{P_t} v_t^{NF}
\]

Because intermediate firms are perfectly competitive, the price of goods is equal to the real marginal cost, \( MC_{F,t} \) and \( MC_{NF,t} \) in the two sectors, respectively. Profit equals revenue net wages and rental rate of capital. Then, vacancy posting costs are deducted, too. Because there are two sectors and the profits are expressed in economy-wide price level \( P_t \), relative sectoral prices are taken into account when calculating total vacancy posting costs. The last term in the family firm profit is related to family organisational investment. In particular, some part of family production, \( I_{OF,t} \), is not sold in the market, but it is used by the firm itself as investment into organisational capital to enhance future production. Because the family firm invests into family organisational capital itself, the price of investment equals the price of goods produced.

Intermediate firms maximize their expected discounted lifetime profit by choosing labor, number of vacancies and physical capital, taking into account the production functions and labor laws of motion above.

\[
\max E_0 \sum_{j=0}^{\infty} \beta_{t,t+j} Prof_{F,t+j}^I \\
\max E_0 \sum_{j=0}^{\infty} \beta_{t,t+j} Prof_{NF,t+j}^I
\]

\( \beta_{t,t+j} \) denotes the stochastic discount factor of the household. Family firms face an extra decision, namely, they also optimize with respect to family organisational investment and capital.
Optimization of family firms implies a usual physical capital demand:

\[
RK_{F,t} = MC_{F,t}(1 - \alpha_F - \mu) \frac{Y_{F,t}^I}{K_{F,t-1}}
\]

Demand for labor, however, differs from the standard one without labor market frictions, namely, firm values of the current and next period have an effect on real wage:

\[
W_{F,t} = MC_{F,t} \alpha_F \frac{Y_{F,t}^I}{L_{F,t}} - F_{F,t} + \beta_{t,t+1}\rho^F F_{F,t+1}
\]

where the current firm value \( F_{F,t} \) is related to the vacancy posting cost of the family sector:

\[
F_{F,t} = \kappa^F P_{F,t} \frac{1}{P_t q_t^F}
\]

Combining these two yields the wage setting equation in the family sector:

\[
W_{F,t} = MC_{F,t} \alpha_F \frac{Y_{F,t}^I}{L_{F,t}} - \kappa^F P_{F,t} \frac{1}{P_t q_t^F} + \beta_{t,t+1}\rho^F \kappa^F P_{F,t+1} \frac{1}{P_{t+1} q_{t+1}^F}
\]

Similarly, in the non-family sector:

\[
RK_{NF,t} = MC_{NF,t}(1 - \alpha_{NF}) \frac{Y_{NF,t}^I}{K_{NF,t-1}}
\]

\[
W_{NF,t} = MC_{NF,t} \alpha_{NF} \frac{Y_{NF,t}^I}{L_{NF,t}} - F_{NF,t} + \beta_{t,t+1}\rho^{NF} F_{NF,t+1}
\]

\[
F_{NF,t} = \kappa^{NF} P_{NF,t} \frac{1}{P_t q_t^{NF}}
\]

Additionally, in the family sector, there is a demand for family organisational capital:

\[
Q_{OF,t} - \beta_{t,t+1}(1 - \delta_{OF})Q_{OF,t+1} = \beta_{t,t+1}MC_{F,t+1} \mu \frac{Y_{F,t+1}^I}{K_{OF,t}}
\]

In contrary to the family physical capital demand, not current period’s production, but next period’s production is relevant, as the firm decides about next period’s organisational capital today, taking this period’s organisational capital as given. Also, this is the reason why not only current period’s, but next period’s capital prices appear.

Similarly to physical capital, there is also a Tobin-Q equation for family organisational capital as follows:

\[
MC_{F,t} = \theta Q_{OF,t} - Q_{OF,t} \phi^{IOF} \left( \frac{I_{OF,t}^3}{I_{OF,t-1}^3} - 4 \frac{I_{OF,t}}{I_{OF,t-1}} + 1 \right) + \\
+ \beta_{t,t+1}Q_{OF,t+1} \phi^{IOF} \left( \frac{I_{OF,t+1}^3}{I_{OF,t}^3} - \frac{I_{OF,t+1}^2}{I_{OF,t}^2} \right) + \\
+ \beta_{t,t+1}Q_{OF,t+1} \phi^{IOF} \left( \frac{I_{OF,t+1}^3}{I_{OF,t}^3} - 4 \frac{I_{OF,t+1}}{I_{OF,t}} + 1 \right)
\]
θ, the effectiveness of family organisational investment has an impact on the price of family organisational capital. In steady state, the price of family organisational capital is equal to \( \frac{MC}{\theta} \), so the higher the effectiveness of family organisational investment, the lower the price of family organisational capital. Again, the price of family organisational capital is related to the price of production, as the family firm sacrifices its own goods to invest into this inheritable special knowlegde.

Intermediate firms and workers bargain over after tax real wages, in period \( t \) they bargain over wages paid in period \( t \). Bargaining happens after matching is over. My framework closely follows that of Stahler-Thomas (2012). Rearranging labor demand functions give the firm values:

\[
F_{F,t} = MC_{F,t} \alpha_F \frac{Y_{F,t}}{L_{F,t}} - W_{F,t} + \beta_{t,t+1} p^F_F \cdot F_{F,t+1}
\]

\[
F_{NF,t} = MC_{NF,t} \alpha_{NF} \frac{Y_{NF,t}}{L_{NF,t}} - W_{NF,t} + \beta_{t,t+1} p^{NF} \cdot F_{NF,t+1}
\]

The current firm value depends on the difference between marginal revenue of the firm and real wage paid; while it is also related to next period’s firm value, taking into account the dismissal rate of workers. \( \beta_{t,t+1} \) is the same stochastic discount factor as before.

Value of working in the family sector at the end of period \( t \) is equal to after tax real wage in period \( t \) and the discounted worker value in period \( t+1 \). This latter is a sum of remaining employed in the family sector with probability \( \rho^F \), plus the value of being unemployed at the beginning of period \( t+1 \) with probability of losing the job:

\[
V_{F,t} = (1 - \tau_L)^t W_{F,t} + \beta_{t,t+1} (\rho^F V_{F,t} + (1 - \rho^F) UV_{b,t+1})
\]

A similar expression holds for worker value of being employed in the non-family sector at the end of period \( t \):

\[
V_{NF,t} = (1 - \tau_L)^t W_{NF,t} + \beta_{t,t+1} (\rho^{NF} V_{NF,t} + (1 - \rho^{NF}) UV_{b,t+1})
\]

Those, who are unemployed at the beginning of period \( t \) (\( U_b \)) plus those who get fired at the beginning of period \( t \), can search for a new job, their value function is:

\[
UV_{b,t} = p^F_F V_{F,t} + p^{NF}_F V_{NF,t} + (1 - p^F_F - p^{NF}_F) UV_{e,t}
\]

With probability \( p^F_F \) she finds a job in the family sector, with probability \( p^{NF}_F \) she finds a job in the non-family sector, while with probability \( 1 - p^F_F - p^{NF}_F \) she does not find a job in period \( t \), so at the end of period \( t \) she is still unemployed. Those who are unemployed at the end of period \( t \) receive unemployed benefit from the government, and can search again in the next period:

\[
UV_{e,t} = W_U + \beta_{t,t+1} UV_{b,t+1}
\]
Workers and intermediate firms bargain over the net surplus in the two sectors separately:

\[
\max (V_{F,t}(W_{F,t}) - UV_{e,t})^{\lambda_F} F_{F,t}(W_{F,t})^{1-\lambda_F} \\
\max (V_{NF,t}(W_{NF,t}) - UV_{e,t})^{\lambda_{NF}} F_{NF,t}(W_{NF,t})^{1-\lambda_{NF}}
\]

Here, \(\lambda_F\) and \(\lambda_{NF}\) denote bargaining powers of workers in the family and non-family sector, respectively.

Bargaining results in the following two first order conditions:

\[
\lambda_F F_{F,t} (1 - \tau_{L,t}) = (1 - \lambda_F) (V_{F,t} - UV_{e,t}) \\
\lambda_{NF} F_{NF,t} (1 - \tau_{L,t}) = (1 - \lambda_{NF}) (V_{NF,t} - UV_{e,t})
\]

### 2.3 Final good producing firms

Similarly to Gertler et al (2008), there is a continuum of \((0, 1)\) of final good producing firms who set final good prices. Final firm \(s\) in the family (non-family) sector sells \(Y_{F,t}^F(s)\) (\(Y_{NF,t}^F(s)\)) amount of final good at price \(P_{F,t}(s)\) (\(P_{NF,t}(s)\)).

Total final output is a Dixit-Stiglitz aggregator (Dixit-Stiglitz, 1977) of all \(s \in (0, 1)\) final goods:

\[
Y_{F,t}^F = \left( \int_0^1 Y_{F,t}^F(s) \frac{\epsilon_F}{\epsilon_F - 1} ds \right)^{\frac{\epsilon_F}{\epsilon_F - 1}} \\
Y_{NF,t}^F = \left( \int_0^1 Y_{NF,t}^F(s) \frac{\epsilon_{NF}}{\epsilon_{NF} - 1} ds \right)^{\frac{\epsilon_{NF}}{\epsilon_{NF} - 1}}
\]

\(\epsilon_F\) is an elasticity parameter which is related to family firm markup; the markup in the family sector is \(\epsilon_F\). Similarly, \(\epsilon_{NF}\) is related to non-family markup.

The demand for each final good \(s\) is:

\[
Y_{F,t}^F(s) = \left( \frac{P_{F,t}}{P_{F,t}(s)} \right)^{\epsilon_F} Y_{F,t}^F \\
Y_{NF,t}^F(s) = \left( \frac{P_{NF,t}}{P_{NF,t}(s)} \right)^{\epsilon_{NF}} Y_{NF,t}^F
\]

Total final good price is a function of all \(s \in (0, 1)\) final good prices:

\[
P_{F,t} = \left( \int_0^1 P_{F,t}(s)^{1-\epsilon_F} ds \right)^{\frac{1}{1-\epsilon_F}} \\
P_{NF,t} = \left( \int_0^1 P_{NF,t}(s)^{1-\epsilon_{NF}} ds \right)^{\frac{1}{1-\epsilon_{NF}}}
\]
There is price stickiness following Rotemberg (1982). There is a quadratic cost of changing prices, which is zero in steady state, but around the steady state it varies depending on the ratio of current price level of final firm $s$ to previous period price level of final firm $s$, and the total value of final firm output. So the profits of final firms $s$ in the two sectors are:

$$\text{Prof}_{F,t}^s = \frac{P_{F,t}^s - MC_{F,t}P_t}{P_{F,t}}Y_{F,t}^s - \frac{\phi^F}{2} \left( \frac{P_{F,t}^s}{P_{F,t-1}^s} - 1 \right)^2 Y_{F,t}^s$$

$$\text{Prof}_{NF,t}^s = \frac{P_{NF,t}^s - MC_{NF,t}P_t}{P_{NF,t}}Y_{NF,t}^s - \frac{\phi^{NF}}{2} \left( \frac{P_{NF,t}^s}{P_{NF,t-1}^s} - 1 \right)^2 Y_{NF,t}^s$$

Intermediate firms sell their goods at prices of $MC_{F,t}$ and $MC_{NF,t}$. $\phi^F$ ($\phi^{NF}$) is the price rigidity parameter, and $\pi$ is the economy wide steady state quarterly inflation rate. Profits are expressed in $P_{F,t}$ and $P_{NF,t}$ price levels.

Final firms maximize expected discounted lifetime profit given the demand functions above:

$$E_0 \sum_{j=0}^{\infty} \beta_{t,t+j} \text{Prof}_{F,t+j}^F(s)$$

$$E_0 \sum_{j=0}^{\infty} \beta_{t,t+j} \text{Prof}_{NF,t+j}^F(s)$$

where $\beta_{t,t+j}$ is the usual stochastic discount factor. Optimization is done with respect to $P_{F,t}(s)$ ($P_{NF,t}(s)$).

Then, optimal pricing decisions are:

$$\phi^F \left( \frac{\pi_t^F}{\pi} - 1 \right) \frac{\pi_t^F}{\pi} = 1 - \epsilon_F + \epsilon_F \frac{MC_{F,t}}{P_{F,t}} + \beta_{t,t+1} \phi^F \left( \frac{\pi_{t+1}^F}{\pi} - 1 \right) \frac{\pi_{t+1}^F}{\pi} Y_{F,t+1}^F$$

$$\phi^{NF} \left( \frac{\pi_t^{NF}}{\pi} - 1 \right) \frac{\pi_t^{NF}}{\pi} = 1 - \epsilon_{NF} + \epsilon_{NF} \frac{MC_{NF,t}}{P_{NF,t}} + \beta_{t,t+1} \phi^{NF} \left( \frac{\pi_{t+1}^{NF}}{\pi} - 1 \right) \frac{\pi_{t+1}^{NF}}{\pi} Y_{NF,t+1}^{NF}$$

where $\pi_t^F$ and $\pi_t^{NF}$ are sectoral inflation rates:

$$\pi_t^F = \frac{P_{F,t}}{P_{F,t-1}}$$

$$\pi_t^{NF} = \frac{P_{NF,t}}{P_{NF,t-1}}$$

After loglinearising and rearranging the pricing decisions, the sectoral New-Keynesian Philips curves are:

$$\dot{\pi}_t^F = \frac{\epsilon_F MC_F}{\phi_F P_F} \left( M\dot{C}_{F,t} - \dot{P} F_{F,t} \right) + \beta \dot{\pi}_{t+1}^F$$

$$\pi_t^{NF} = \frac{\epsilon_{NF} MC_{NF}}{\phi_{NF} P_{NF}} \left( M\dot{C}_{NF,t} - \dot{P} N_{F,t} \right) + \beta \pi_{t+1}^{NF}$$
where
\[ PFP_t = \frac{PF_t}{P_t} \text{ and } PNFP_t = \frac{PNF_t}{P_t} \]

These Philips curves are similar to the usual Philips curve, apart from the fact that they contain relative sectoral prices. Substituting \( PF_t = P_t \) and \( NFP_t = P_t \) (ie. \( PFP_t = 0 \) and \( PNFP_t = 0 \)) into the sectoral Philips-curves, one can immediately see that we get back the standard Philips curve.

### 2.4 Monetary authority and government

The central bank sets the next period interest rate based on current period inflation, following a simple Taylor-rule:
\[ \hat{i}_t = \rho \pi_t + \epsilon_t^i \]
where \( \rho \pi \) is the weight on inflation in the Taylor-rule, and \( \epsilon_t^i \) is the exogenous monetary policy shock.

The government collects taxes: labor income tax (including social security contributions of employers and employees), value added tax and a lump-sum tax. For simplicity, I assume that interest income of bond holdings and physical capital renting income are not taxed. Taxes are used to finance government consumption expenditure \( G_t \) and unemployment benefit expenditure.

\[
\begin{align*}
Rev_t &= \tau_L (W_{F,t}L_{F,t} + W_{NF,t}L_{NF,t}) + \tau_C C_t + T_t \\
Exp_t &= G_t + W_U(1 - L_{F,t} - L_{NF,t})
\end{align*}
\]

Then, government deficit is defined as the difference between government expenditures and revenues:
\[ DEF_t = Exp_t - Rev_t \]

The government issues bonds to finance government deficit, these bonds are bought by the household:
\[ DEF_t = B_t - \frac{1 + \delta_{l-1}}{\pi_t} B_{l-1} \]

In order to avoid an explosive solution, there is a lump sum tax rule which depends on the government debt-output ratio:
\[ T_t = T(T_{l-1})^{\rho_T} \left( \frac{B_{l-1}}{Y} \right)^{(1-\rho_T)\xi_B} \exp(\epsilon_{T,t}) \]
Here, \( \rho_T \) is the autocorrelation parameter, \( \xi_B \) is the debt rule parameter and \( \epsilon_{T,t} \) is the lump sum tax shock. If the government debt-output ratio goes up, compared to its steady state value, lump sum tax increases.
Similarly to aggregate household consumption, aggregate government consumption is a composite of goods produced by family and non-family firms. The composite and demand functions are as follow:

\[ G_t = \left[ \gamma \frac{1}{n} G_{F,t}^n + (1 - \gamma) \frac{1}{n} G_{NF,t}^n \right]^{\frac{1}{n}} \]

\[ G_{F,t} = \gamma \left( \frac{P_{F,t}}{P_t} \right)^{-\eta} G_t \]

\[ G_{NF,t} = (1 - \gamma) \left( \frac{P_{NF,t}}{P_t} \right)^{-\eta} G_t \]

For simplification, the share of family goods and the elasticity of substitution between family and non-family goods is the same as in case of household consumption, so the price levels are the same, too.

Finally, there is an exogenous shock process for each tax and expenditure item:

\[ \hat{\tau}_{L,t} = \rho_{\tau_L} \hat{\tau}_{L,t-1} + \epsilon_{\tau_L,t} \]

\[ \hat{\tau}_{C,t} = \rho_{\tau_C} \hat{\tau}_{C,t-1} + \epsilon_{\tau_C,t} \]

\[ \hat{G}_t = \rho_G \hat{G}_{t-1} + \epsilon_{G,t} \]

where \( \rho_{\tau_L}, \rho_{\tau_C} \) and \( \rho_G \) are the autocorrelation parameters, while \( \epsilon_{\tau_L,t}, \epsilon_{\tau_C,t}, \) and \( \epsilon_{G,t} \) are the shock error terms.

### 2.5 Market clearing

In equilibrium all markets clear. Physical capital markets clear, i.e. physical capital supplied by household is equal to physical capital demanded by intermediate firms. Similarly, labor markets clear. Also, goods markets clear.

Total final output is equal to total intermediate output:

\[ Y_{F,t} = Y_{F,t}^I - I_{OF,t} \]

\[ Y_{NF,t} = Y_{NF,t}^I \]

Concerning family goods, family organisational investment must be subtracted from intermediate output, as it is not distributed, but used by the family firm itself as an input in future production. This is in line with Danthine-Jin (2007) who point out that from a counting point of view GDP does not contain intangible investment due to the fact that it is treated as an expense, although economically this is incorrect.

Also, output in each sector equals demand in each sector. Final output of family firms is equal to the sum of household and government consumption demand, and private physical investment demand for family firm produced goods. Also, there is a deadweight loss related to vacancy posting, and changing prices:

\[ Y_{F,t} = C_{F,t} + G_{F,t} + I_{F,t} + \kappa_F v_{F,t}^P + \]

\[ + \frac{\phi^F}{2} \left( \frac{P_{F,t} \pi}{P_{F,t-1} \pi} - 1 \right)^2 Y_{F,t} \frac{P_t}{P_{F,t}} \]
Similarly, for the non-family sector:

\[
Y_{NF,t}^F = C_{NF,t} + G_{NF,t} + I_{NF,t} + \kappa_{NF,t}^F + \\
\phi_{NF,t}^2 \left( \frac{P_{NF,t}(s)}{P_{NF,t-1}(\pi)} - 1 \right)^2 Y_{NF,t}^F \frac{P_t}{P_{NF,t}}
\]

Finally, total output (GDP) is defined as follows:

\[
P_t Y_t = P_F Y_F + P_{NF,t} Y_{NF,t}
\]

### 3 Calibration

In the steady state, the share of family firms in labor force and the level of unemployment, and also the share of family firm produced goods in household and government consumption basket are calibrated such that they match data of countries with a share of family firms in employment above than average. So, the share of family firms in labor force is 56.4 per cent and the share of family firm produced goods in household and government consumption basket is 0.6008 based on Mandl (2008). The unemployment rate is 8.1 per cent, based on Eurostat data between 2000 and 2012.

The discount rate \( \beta \) is set to 0.99, which is a standard value in the literature. The steady state quarterly rate of inflation is 0. Price markups are 10 per cent in both sectors, and all the quarterly depreciation rates are 2.5 per cent, following usual values in the literature. Family and non-family labor income shares are set to the common value of 0.7. The price elasticity of demand is assumed to be 1.5, due to lack of data.

Both productivity levels are normalised to 1 in the steady state. There is no consensus in the corporate finance literature, whether family firms are more or less productive than non-family firms, so for simplicity I consider the same levels, and I check the sensitivity of the results with respect to this. The effectiveness of family organisational investment is 1, which, following McGrattan-Prescott (2010), assumes that the accumulation process of intangible capital is the same as the usual accumulation process of physical capital. The sensitivity of the results with respect to this is also examined later on.

The steady state ratio of household consumption to GDP is 57.62 per cent, based on Eurostat data of Euro Area countries between 2000 and 2012. The steady state deficit to GDP ratio is 3 per cent following the Maastrict Treaty. The steady state value of the effective value added tax rate is 12.78 per cent, following the OECD and taking into account the great ratio of household consumption to GDP. Then, the steady state of the effective labor income tax rate, including both employers’ and

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\( ^{22} \) See the Introduction for more detail.

\( ^{23} \) When calculating this ratio, GDP was modified by net exports, as my model is a closed economy.
employees’ social security contributions, is 37.76 per cent following the Eurostat. Both tax rates are similar to those of Stahler-Thomas (2012). The gross steady state replacement rate of unemployment benefit is 28.03 per cent, following the OECD.

There is a wide range of values as regards the unemployment benefit replacement rate in the literature. Esser et al (2009) find that the average gross rate is around 50 per cent in the Euro Area, which is significantly higher than the value I consider. The implied value of Monacelli et al (2010) is slightly above 10 per cent only, while Christoffel et al (2009) set this rate to 65 per cent. The most common value is around 0.3-0.4, usually in models of the US a lower value is considered than in models of the Euro Area, in line with the empirical evidence.

Gourio-Rudanko (2014) claim that about 11 per cent of employment is related to sales. They consider a similar value to calibrate the weight of customer capital, an intangible capital, representing the relationship between firms and customers. Dynastic management is also a latent term, modeled by an intangible capital, representing the relationship of current and previous managers of the firm. Its importance is obviously hard to estimate. By assumption, I calibrate the level of organisational to physical capital in the family sector to 11 per cent, following Gourio-Rudanko (2014) and check the sensitivity of the results.

I am not aware of any information concerning the ratio of sectoral price levels. Nevertheless, Bassanini et al (2011) find that family wage is 5 per cent lower than the non-family wage, so I consider a similar gap between the sectoral price levels. Sraer-Thesmar (2007) find a similar wage penalty, about 4.5 per cent, even though they did not consider non-listed companies as Bassanini et al (2011) did. Bassanini et al (2011) is the only paper which estimates dismissal rates, too, they find that the dismissal rate of family firms is 0.16 percentage points lower than the dismissal rate of non-family firms. Dismissal rates in the literature vary between 1.8 per cent of Bermporoglou et al (2013), which is close to the estimated separation rates of Hobijn-Sahin (2007), and 10.5 per cent of Gertler et al (2008), which is similar to the 8-10 per cents reported by Hall (1995). I set the non-family dismissal rate to 6 per cent which is the middle point, following Stahler-Thomas (2012), and then the family dismissal rate is 5.84 per cent taken into account the finding of Bassanini et al (2011) described above.

Bassanini et al (2011) show evidence that the bargaining power of workers, ie. the importance of unions, is higher in the non-family sector, 0.807, compared to the family sector, where it is only 0.495. Hosios (1990) claim that an efficient solution requires that the bargaining power of workers is equal to the matching elasticity in the matching function, so I set the sectoral matching elasticities accordingly. My

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24Other papers usually only consider a lump sum tax, apart from Bermperoglou et al (2013).
25The effective tax rates and the gross replacement rate of unemployment benefit are also based on Euro Area data between 2000 and 2012.
26It is not straightforward though how to compare the replacement rates as some models only contain a lump sum tax, so there is no clear difference between gross and net wages and so gross and net unemployment benefit replacement rates.
non-family bargaining power is higher than usual values, 0.3-0.5, of the literature (Mortensen-Nagypal, 2007), apart from Gertler et al (2008) who estimate a value of 0.907. Most papers, following Hosios (1990), set the matching elasticity equal to the bargaining power of workers, except Gertler et al (2008) who calibrate the matching elasticity to be 0.5 which is much lower. As another exception, Christoffel et al (2009) consider a somewhat higher matching elasticity than their bargaining power of workers (0.6 and 0.5, respectively).

Similarly to the dismissal rates, there is a wide range of values available in the literature regarding the ratios of vacancy costs to wages. Bruckner-Pappa (2012) and Bermperoglou et al (2013) use a value of 4.5 per cent following Hagedorn-Manovski (2008). But others, e.g. Christoffel et al (2009) and Stahler-Thomas (2012), consider higher values, around 6-7 per cents, while the highest value is used by Gertler et al (2008), almost 9 per cent. I calibrate these ratios to 7 per cent in both sectors which is in the middle of the range.

My calibration implies that the job finding rates are 22.41 and 17.76 per cent in the family and non-family sectors, respectively. This in line with Euro Area unemployment duration, according to the Eurostat, between 2000 and 2012, about 23 per cent of unemployed people found a job in 1-2 months, while about 38 per cent found a job in less than 5 months. These values are also similar to those of Christoffel et al (2009) and Stahler-Thomas (2012). Nevertheless, the values considered for the US are usually higher, 83 per cent in Bermperoglou et al (2013) and in Bruckner-Pappa (2012) and 45 per cent in Shimer (2005).

As regards the job filling probabilities, my values are lower than those in the literature, 27.37 and 13.05 per cent in the family and non-family sectors, respectively. For the US, Bermperoglou et al (2013) and Bruckner-Pappa (2012) consider $\frac{2}{3}$, while for the Euro Area, Christoffel et al (2012) and Stahler-Thomas (2012) use 0.7. The reason is that in my model, compared to others, the job filling probability is linearly and positively related to the vacancy cost. Thus, there is a tradeoff setting both close to other values in the literature. I calibrated the model such that the vacancy posting cost is as similar to other values in the literature as possible, at the price of accepting somewhat lower job filling probabilities. Finally, the implied share of total vacancy costs in GDP is 1.47 per cent, while the matching efficiencies are 0.2479 and 0.1674 in the family and non-family sectors, respectively.

Regarding the dynamic parameters, the relative risk aversion is 1.38 and the external habit in consumption is 0.71, following Smets-Wouters (2007). Also, based on Smets-Wouters (2007), the inflation weight in the Taylor rule is 2.04 and the sectoral price rigidity is 66 per cent. The debt sensitivity parameter in the lump sum tax rule is set to 2 following Bermperoglou et al (2013). Furthermore, based on Christiano et al (2005), all investment adjustment costs are 2.48. As an assumption all the shock autocorrelation parameters are 0.75.

See the first order conditions with respect to the number of posted vacancies in Section 2.

Because my model contains Rotemberg price rigidity, and not Calvo price rigidity, Lombardo-Vestin (2007)'s approach is followed to calculate the Rotemberg parameters in line with the Calvo ones.
<table>
<thead>
<tr>
<th>Notation</th>
<th>Name</th>
<th>Value</th>
<th>Source</th>
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<td>0.025</td>
<td>standard</td>
</tr>
<tr>
<td>$\delta_{sF}$</td>
<td>NF physical capital depreciation rate</td>
<td>0.025</td>
<td>standard</td>
</tr>
<tr>
<td>$\delta_{F}$</td>
<td>F organisational capital depreciation rate</td>
<td>0.025</td>
<td>standard</td>
</tr>
<tr>
<td>$\omega_F$</td>
<td>labor income share in F</td>
<td>0.7</td>
<td>standard</td>
</tr>
<tr>
<td>$\omega_{sF}$</td>
<td>labor income share in NF</td>
<td>0.7</td>
<td>standard</td>
</tr>
<tr>
<td>$\lambda_F$</td>
<td>SS productivity level in F</td>
<td>1</td>
<td>simplifying assumption</td>
</tr>
<tr>
<td>$\lambda_{sF}$</td>
<td>SS productivity level in NF</td>
<td>1</td>
<td>simplifying assumption</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>share of family firm produced goods in aggregate household government consumption</td>
<td>0.6008</td>
<td>Mandell (2008), GIE (2009), IFB (2011), Bjuggren et al (2011) and Lindow (2013), own calculation</td>
</tr>
<tr>
<td>$\theta$</td>
<td>effectiveness of F organisational investment</td>
<td>1</td>
<td>simplifying assumption</td>
</tr>
<tr>
<td>$C/Y$</td>
<td>SS ratio of household consumption to output</td>
<td>0.5762</td>
<td>Eurostat, own calculation</td>
</tr>
<tr>
<td>DEF/Y</td>
<td>SS ratio of government deficit to output</td>
<td>0.03</td>
<td>Maastricht criterion</td>
</tr>
<tr>
<td>L_F</td>
<td>SS F workforce</td>
<td>0.5188</td>
<td>Eurostat and Mandell (2008), GIE (2009), IFB (2011), Bjuggren et al (2011) and Lindow (2013), own calculation</td>
</tr>
<tr>
<td>L_{sF}</td>
<td>SS NF workforce</td>
<td>0.4094</td>
<td>Eurostat and Mandell (2008), GIE (2009), IFB (2011), Bjuggren et al (2011) and Lindow (2013), own calculation</td>
</tr>
<tr>
<td>U</td>
<td>SS unemployment rate</td>
<td>0.0899</td>
<td>Eurostat and Mandell (2008), GIE (2009), IFB (2011), Bjuggren et al (2011) and Lindow (2013), own calculation</td>
</tr>
<tr>
<td>$\tau_F$</td>
<td>SS effective value added tax rate</td>
<td>0.1278</td>
<td>Eurostat</td>
</tr>
<tr>
<td>$\tau_s$</td>
<td>SS effective labor income tax rate (including social security contributions of employers and employees)</td>
<td>0.3776</td>
<td>OECD</td>
</tr>
<tr>
<td>$b$</td>
<td>ratio of unemployment benefit to SS average gross real wage</td>
<td>0.2803</td>
<td>OECD</td>
</tr>
<tr>
<td>$p_F/p_{sF}$</td>
<td>ratio of F price level to NF price level in SS</td>
<td>0.95</td>
<td>simplifying assumption, Bassanini et al (2011) and Stahler-Thomas (2012)</td>
</tr>
<tr>
<td>$p_{sF}$</td>
<td>NF dismissal rate</td>
<td>0.0584</td>
<td>Stahler-Thomas (2012)</td>
</tr>
<tr>
<td>$K_{F}/K_{sF}$</td>
<td>ratio of F organisational capital to F physical capital in SS</td>
<td>0.11</td>
<td>simplifying assumption, Giorio-Rudenko (2014)</td>
</tr>
<tr>
<td>$\lambda_{s}$</td>
<td>F bargaining power of workers</td>
<td>0.495</td>
<td>Bassanini et al (2011)</td>
</tr>
<tr>
<td>$\sigma_F$</td>
<td>matching elasticity</td>
<td>0.495</td>
<td>Bassanini et al (2011)</td>
</tr>
<tr>
<td>$\lambda_{sF}$</td>
<td>NF bargaining power workers</td>
<td>0.807</td>
<td>Bassanini et al (2011)</td>
</tr>
<tr>
<td>$\omega_{sF}$</td>
<td>NF matching elasticity</td>
<td>0.807</td>
<td>Bassanini et al (2011)</td>
</tr>
<tr>
<td>$\eta$</td>
<td>price elasticity of demand</td>
<td>1.5</td>
<td>assumption</td>
</tr>
<tr>
<td>$\kappa_{W_{sF}}$</td>
<td>ratio of F vacancy cost to SS F gross real wage</td>
<td>0.07</td>
<td>assumption</td>
</tr>
<tr>
<td>$\kappa_{sW_{sF}}$</td>
<td>ratio of NF vacancy cost to SS NF gross real wage</td>
<td>0.07</td>
<td>assumption</td>
</tr>
</tbody>
</table>

F stands for family firm, NF stands for non-family and SS stands for steady state.

Table 3: Steady state parameters
<table>
<thead>
<tr>
<th>Notation</th>
<th>Name</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma_C$</td>
<td>relative risk aversion</td>
<td>1.38</td>
<td>Smets-Wouters (2007)</td>
</tr>
<tr>
<td>$h$</td>
<td>external habit in consumption</td>
<td>0.71</td>
<td>Smets-Wouters (2007)</td>
</tr>
<tr>
<td>$\phi_F$</td>
<td>price rigidity parameter, when share of firms who do not set prices in F is 66 %</td>
<td>56.0062</td>
<td>Smets-Wouters (2007) and Lombardo-Vestin (2007)</td>
</tr>
<tr>
<td>$\phi_{NF}$</td>
<td>price rigidity parameter, when share of firms who do not set prices in NF is 66 %</td>
<td>56.0062</td>
<td>Smets-Wouters (2007) and Lombardo-Vestin (2007)</td>
</tr>
<tr>
<td>$\gamma_\pi$</td>
<td>inflation parameter in Taylor rule</td>
<td>2.04</td>
<td>Smets-Wouters (2007)</td>
</tr>
<tr>
<td>$\chi_\pi$</td>
<td>debt rule parameter in lump sum tax rule</td>
<td>2</td>
<td>Berman et al (2013)</td>
</tr>
<tr>
<td>$\phi_{IF}$</td>
<td>F physical investment adjustment cost</td>
<td>2.48</td>
<td>Christiano et al (2005)</td>
</tr>
<tr>
<td>$\phi_{IF}$</td>
<td>NF physical investment adjustment cost</td>
<td>2.48</td>
<td>Christiano et al (2005)</td>
</tr>
<tr>
<td>$\phi_{IF}$</td>
<td>F organisational investment adjustment cost</td>
<td>2.48</td>
<td>Christiano et al (2005)</td>
</tr>
<tr>
<td>$\phi_{IF}$</td>
<td>all autocorrelation parameters</td>
<td>0.75</td>
<td>assumption</td>
</tr>
</tbody>
</table>

F stands for family firm, and NF stands for non-family firm.

Table 4: Dynamic parameters
Tables 3 and 4 summarize the calibration process. After calibrating the model, it is loglinearised and solved by Dynare 4.4.2. The steady state of the model and the loglinearised equations are available in a separate Technical Appendix.

4 Results

4.1 Baseline results

Three fiscal austerity policies are considered, all of them are 1 per cent of GDP size: i) a decrease in government consumption, ii) an increase in the value added tax rate, and iii) an increase in the labor income tax rate. Table 5 shows the unemployment multipliers: i) at peak and ii) cumulatively. A peak multiplier is the highest response in absolute value after the shock, while the cumulative multipliers are the sum of the first one, two and four years. All multipliers are presented in percentage point deviations from the steady state.

<table>
<thead>
<tr>
<th></th>
<th>Government consumption cut</th>
<th>Value added tax increase</th>
<th>Labor income tax increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak</td>
<td>0.631</td>
<td>0.015</td>
<td>0.144</td>
</tr>
<tr>
<td>Cumulative (1 year)</td>
<td>0.888</td>
<td>0.039</td>
<td>0.419</td>
</tr>
<tr>
<td>Cumulative (2 years)</td>
<td>0.834</td>
<td>0.055</td>
<td>0.682</td>
</tr>
<tr>
<td>Cumulative (4 years)</td>
<td>0.606</td>
<td>0.032</td>
<td>0.637</td>
</tr>
</tbody>
</table>

Table 5: Unemployment multipliers (in percentage points)

I can conclude that fiscal consolidation raises unemployment. At peak, the highest increase is implied by a government consumption cut, 0.63 percentage points. A labor income tax hike and a value added tax hike imply a lower peak effect, 0.14 and 0.02 percentage points, respectively. Nevertheless, the cumulative multipliers show a somewhat different picture. On the whole, during the four years, a labor income tax hike causes the highest, 0.64 percentage points, increase in unemployment. At the same time, over a shorter time horizon, the government consumption cut multiplier still exceeds the labor income tax multiplier, so the latter policy implies a more prolonger response. A value added tax hike does not only imply the lowest peak, but also the lowest cumulative response in unemployment.

To sum up, my results suggests that if the aim of the government is to consolidate the budget at the lowest price in terms of employment, a value added tax increase should be implemented. However, unemployment is clearly not the only concern of the government. Regarding output, all policies, apart from the value added tax policy, imply a decline in output. There is a 0.5 per cent decline after a government consumption cut and a 0.1 per cent loss of output after a labor income tax hike.

Stochastic impulse responses are presented in Figures 2-4 of the Appendix.
Also, not only the reaction of GDP, but also that of household consumption differs among the different policies. The only policy which raises household consumption is the government consumption cut, by about 0.8 per cent at peak. However, household consumption considerably goes down when the value added tax goes up, while a labor income tax hike also implies a decline in it (peak effects are 0.25 and 0.15 per cents, respectively).

In connection with this, a revenue-based fiscal consolidation policy implies a decrease, while an expenditure-based fiscal consolidation implies an increase in welfare, which is the expected discounted sum of lifetime household utility:

$$ W_t = E_t \sum_{s=t}^{\infty} \beta^{s-t} u(C_s) $$

Table 6 shows the percentage changes in welfare associated with each policy compared to the relevant steady state level. Consolidating the budget by cutting back on the government consumption results in a welfare gain of 3.2 per cent. However, a same size of revenue-based budget consolidation implies a welfare loss, 2 per cent if the value added tax rate is increased and 2.6 per cent if the labor income tax rate is increased. Thus, there are trade-offs a policy maker must face. Namely even though consolidating the budget by increasing the value added tax rate is the least costly in terms of employment, this policy implies a considerable welfare loss.

<table>
<thead>
<tr>
<th>Percentage change in welfare compared to its steady state level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government consumption cut</td>
</tr>
<tr>
<td>Value added tax increase</td>
</tr>
<tr>
<td>Labor income tax increase</td>
</tr>
</tbody>
</table>

Table 6: Welfare impact of fiscal austerity

Policy combinations might be a solution to handle this trade-off. Given the debate on shifting the focus of taxation from labor income towards value added taxes, I had a look at a combined policy, namely a 1 per cent of GDP increase in value added tax revenue and a 1 per cent of GDP decrease in labor income tax revenue, keeping the deficit unchanged. This combined policy implies a 0.12 percentage point decline in unemployment, at peak. At the same time, household consumption goes down less than it does when there is a value added tax increase and output goes up compared to a decline following a labor income tax hike.

---

30Impulse responses are presented in Figure 5.
4.2 The role of firm heterogeneity

Three alternative scenarios are considered, i) one in which the only sector is the family sector, ii) another one where the only sector is the non-family sector, iii) and a two-sectoral framework but without family organisational capital.

Neglecting firm heterogeneity creates a bias.\(^{31}\) Both at peak and cumulatively, unemployment multipliers of government consumption and labor income taxation are considerably lower in the one-sector models than in the two-sector model. The same is true if the organisational capital is not included in the framework, although multipliers go down less compared to the baseline case. Regarding value added tax multipliers, the picture is somewhat controversial, but still this policy is always the least costly in terms of employment. Thus, firm heterogeneity is crucial when estimating the effects of fiscal austerity on unemployment. Assuming that firms are homogeneous might explain the gap between empirical and theoretical multipliers reported by Monacelli et al (2010).

4.3 Robustness with respect to parameter values

Tables 8 and 9 of the Appendix show unemployment multipliers with different parameter values. The multipliers are very robust with respect to most of the parameters, apart from: i) the replacement rate of unemployment benefit, ii) the non-family bargaining power of workers, iii) the family productivity level, and iv) the level of price rigidity in the family sector, especially this last one.

Regarding the unemployment benefit replacement rate, there is a wide range of values in the literature, which was summarised in the Section 3. As already pointed out by Gertler et al (2008), this ratio is crucial for the impulse responses of a model with search and matching frictions. When decreasing this ratio, at peak and cumulatively, unemployment increases less after a government consumption cut or a labor income tax hike, while the value added tax multipliers do not significantly change. This might be because a lower replacement rate means a lower outside option, so being unemployed becomes less attractive.

Concerning the bargaining power of workers, a lower value in the non-family sector implies lower multipliers of government consumption and labor income taxation, while the value added tax multipliers go up, although they are still pretty low. Now workers have a lower power in setting their wages, so the firms can react more in terms of wages, and so they react less in terms of employment. At the same time, the bargaining power of workers equals the matching elasticity, which might be the reason why the unemployment response of the value added tax shock is more pronounced.

There is no conclusion in the corporate finance literature whether family or non-family firms are more productive.\(^{32}\). Unemployment multipliers of government consumption and labor income taxation are higher, while the value added tax multiplier

\(^{31}\)See Table 7 and Figure 6 in the Appendix.

\(^{32}\)See the Introduction for more detail
becomes lower, if a lower value of family productivity level is considered. This might
be because if a negative shock hits the economy, workers are relatively better off
being unemployed than working in the less productive sector which pays a lower
wage anyway.

There is no evidence either whether family or non-family firms set prices more
often. At the same time, Goldberg-Hellerstein (2011) show that small firms set prices
more often than large firms, and Bach (2010) claims that family firms are usually
smaller than non-family firms. So, I consider an alternative scenario when family
firms set prices more often than non-family firms do. Unemployment multipliers are
mostly affected by varying the level of price rigidity, compared to other sensitivity
checks. This is especially true concerning the value added tax multipliers, the
peak effect changes from 1.5 to 4.4 percentage points, while the cumulative response
increases from 3.2 to 12.8 percentage points, although still the lowest multipliers
are associated with this policy. This is in line with Bruckner-Pappa (2012) who
also stress the importance of price rigidity for unemployment multipliers due to the
demand effect.

Regarding other key parameters of my model, namely sectoral dismissal rates and
the effectiveness of family organisational investment, unemployment multipliers are
highly robust.
Table 7: Unemployment multipliers and firm heterogeneity

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Only family firms</th>
<th>Only non-family firms</th>
<th>Both, but no organisational capital</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Peak</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government consumption cut</td>
<td>0.631</td>
<td>0.201</td>
<td>0.135</td>
<td>0.320</td>
</tr>
<tr>
<td>Value added tax increase</td>
<td>0.015</td>
<td>0.032</td>
<td>0.007</td>
<td>0.020</td>
</tr>
<tr>
<td>Labor income tax increase</td>
<td>0.144</td>
<td>0.038</td>
<td>0.018</td>
<td>0.054</td>
</tr>
<tr>
<td><strong>Cumulative (1 year)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government consumption cut</td>
<td>0.888</td>
<td>0.303</td>
<td>0.202</td>
<td>0.446</td>
</tr>
<tr>
<td>Value added tax increase</td>
<td>0.039</td>
<td>0.093</td>
<td>0.021</td>
<td>0.057</td>
</tr>
<tr>
<td>Labor income tax increase</td>
<td>0.419</td>
<td>0.113</td>
<td>0.050</td>
<td>0.151</td>
</tr>
<tr>
<td><strong>Cumulative (2 years)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government consumption cut</td>
<td>0.834</td>
<td>0.333</td>
<td>0.214</td>
<td>0.471</td>
</tr>
<tr>
<td>Value added tax increase</td>
<td>0.055</td>
<td>0.168</td>
<td>0.033</td>
<td>0.097</td>
</tr>
<tr>
<td>Labor income tax increase</td>
<td>0.682</td>
<td>0.211</td>
<td>0.088</td>
<td>0.261</td>
</tr>
<tr>
<td><strong>Cumulative (4 years)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government consumption cut</td>
<td>0.606</td>
<td>0.279</td>
<td>0.200</td>
<td>0.406</td>
</tr>
<tr>
<td>Value added tax increase</td>
<td>0.032</td>
<td>0.173</td>
<td>0.028</td>
<td>0.088</td>
</tr>
<tr>
<td>Labor income tax increase</td>
<td>0.637</td>
<td>0.261</td>
<td>0.105</td>
<td>0.289</td>
</tr>
</tbody>
</table>
5 Conclusion and discussion

The aim of this paper was to estimate unemployment multipliers of expenditure and revenue-based fiscal austerity policies in the presence of firm heterogeneity. On the one hand, my paper contributes to the literature as, according to my knowledge, this is the first paper which estimates unemployment multipliers of tax-based fiscal austerity policies. On the other hand, firm heterogeneity has not been taken into account in the unemployment multiplier literature yet, although firms are obviously not homogeneous.

I considered a New Keynesian framework with search and matching frictions. As a novelty, on the firm side, there was a distinction between family and non-family firms, focusing i) on the different labor market behavior of family firms compared to non-family firms and ii) on the special way of management of family firms. This latter was modeled by an intangible capital a la Danthine-Jin (2007). The model was calibrated to match the data of countries with high family firm share in employment, while the characteristics of family firms were based on the empirical micro level evidence documented in the corporate finance literature.

As a result, I can conclude that fiscal austerity raises unemployment. At peak, the highest increase in unemployment is implied by a cut in government consumption. Nevertheless, the fiscal instrument implying the highest cumulative increase depends on the time horizon. Generally, a labor income tax hike results in a more prolonged response than a government consumption cut. Both at peak and cumulatively, unemployment reacts least when the budget is consolidated by increasing the value added tax rate. Even though consolidating the budget is the least costly in terms of employment if it happens by a value added tax increase, this policy implies the highest decline in household consumption at peak and so a considerable welfare loss which is an example of trade-offs policymakers have to face.

Firm heterogeneity seems to play a crucial role when estimating unemployment multipliers. Unemployment multipliers are very different with and without firm heterogeneity, in most cases they are biased downwards when homogeneous firms are assumed. Overall, the results are highly robust, although the magnitude of the multipliers is crucially affected by the degree of price rigidity.

There are several features which were beyond the scope of this paper. First, the size of the labor force was fixed, relaxing this assumption might be more relevant in a longer term though. Then, partly related to this, if skill heterogeneity was present, a skill mismatch between workers and firms would affect the sectoral employment flows. Furthermore, although social security contributions were deducted from gross wages, a detailed modeling of the social security system was not done, which would require overlapping generations in the framework. Finally, a significant part of output and employment is in the shadow (Schneider et al, 2010 and Schneider, 2012), the shadow economy can not be directly influenced by the government but is related to unemployment. All of these questions are intresting for further consideration.
6 Appendix

6.1 Baseline stochastic impulse response functions

Figures 2-4 show baseline stochastic impulse response functions of three fiscal consolidation policies (all 1 per cent of GDP size): i) government consumption tax, ii) value added tax increase, and iii) labor income tax increase.

Figure 2: A cut in government consumption equal to 1 per cent of GDP.
Figure 3: An increase in value added tax revenue equal to 1 per cent of GDP
Figure 4: An increase in labor income tax revenue equal to 1 per cent of GDP
Figures 5 presents stochastic impulse responses of a tax shift from labor income to value added taxation (1-1 per cent of GDP), while keeping the budget deficit at its steady state level.

Figure 5: A shift from labor income taxation to value added taxation (a 1 per cent of GDP decrease in labor income tax revenue and a 1 per cent of GDP increase in value added tax revenue)
6.2 Role of firm heterogeneity and robustness of parameter values

Figure 6 shows the stochastic impulse response functions and the importance of firm heterogeneity. The solid line is the baseline model. The dotted line is a one-sector model assuming that all firms are family firms, while the line with the round markers is another one-sector model assuming that all firms are non-family firms. The line with the squared marker is a two-sector model without organisational capital in the family sector.\footnote{Impulse responses of other variables are available upon request.}

![Figure 6: The effect of firm heterogeneity on impulse responses. First column: a cut in government consumption. Second column: an increase in value added tax rate. Third column: an increase in labor income tax rate. All shocks correspond to 1 per cent of GDP.](image)

Tables 8 and 9 present the sensitivity of unemployment multipliers with respect to the following parameter values: i) unemployment benefit replacement rate, ii) bargaining power of workers in the non-family sector (which equals matching elasticity in the non-family sector), iii) dismissal rate of workers in the family sector, iv) family productivity level, v) effectiveness of family organisational investment and vi) the level of price rigidity in the family sector.
<table>
<thead>
<tr>
<th></th>
<th>Peak</th>
<th>Cumulative (1 year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BASELINE</td>
<td>b=0.25</td>
</tr>
<tr>
<td>Government consumption cut</td>
<td>0.631</td>
<td>0.558</td>
</tr>
<tr>
<td>Value added tax increase</td>
<td>0.015</td>
<td>0.014</td>
</tr>
<tr>
<td>Labor income tax increase</td>
<td>0.144</td>
<td>0.115</td>
</tr>
<tr>
<td></td>
<td>A_F=0.99</td>
<td>$\theta=0.975$</td>
</tr>
<tr>
<td>Government consumption cut</td>
<td>0.693</td>
<td>0.644</td>
</tr>
<tr>
<td>Value added tax increase</td>
<td>0.013</td>
<td>0.015</td>
</tr>
<tr>
<td>Labor income tax increase</td>
<td>0.171</td>
<td>0.149</td>
</tr>
<tr>
<td></td>
<td>A_F=0.99</td>
<td>$\theta=0.975$</td>
</tr>
<tr>
<td>Government consumption cut</td>
<td>0.888</td>
<td>0.774</td>
</tr>
<tr>
<td>Value added tax increase</td>
<td>0.039</td>
<td>0.039</td>
</tr>
<tr>
<td>Labor income tax increase</td>
<td>0.419</td>
<td>0.330</td>
</tr>
<tr>
<td></td>
<td>A_F=0.99</td>
<td>$\theta=0.975$</td>
</tr>
<tr>
<td>Government consumption cut</td>
<td>0.989</td>
<td>0.910</td>
</tr>
<tr>
<td>Value added tax increase</td>
<td>0.034</td>
<td>0.038</td>
</tr>
<tr>
<td>Labor income tax increase</td>
<td>0.492</td>
<td>0.433</td>
</tr>
</tbody>
</table>

Table 8: Unemployment multipliers - robustness with respect to parameter values
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Cumulative (2 years)</th>
<th>Cumulative (4 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BASELINE</td>
<td>b=0.25</td>
</tr>
<tr>
<td>Government consumption cut</td>
<td>0.834</td>
<td>0.746</td>
</tr>
<tr>
<td>Value added tax increase</td>
<td>0.055</td>
<td>0.056</td>
</tr>
<tr>
<td>Labor income tax increase</td>
<td>0.682</td>
<td>0.543</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$A_F=0.99$</td>
</tr>
<tr>
<td>Government consumption cut</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value added tax increase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labor income tax increase</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 9: Unemployment multipliers - robustness with respect to parameter values cont.
7 References


