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Essential and non-essential goods: a dynamic stochastic general equilibrium modeling of the infectious disease coronavirus (COVID-19) outbreak[1,2]

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Abstract: Making use of a two-country, two-sector, New Keynesian model with essential and non-essential goods we assess the macroeconomic consequences of a labor supply shock in the Euro Area. Our model incorporates health status in the households' maximization problem which depends on the time devoted to leisure. Health status is linked to the consumption of non-essential goods, such that the demand for non-essentials is decreasing with contemporaneous health. After calibrating the model for the case of Portugal and the rest of the Euro Area, our simulations show that, a labor supply shock affecting only the latter, reduces the demand for non-essential goods, generates inflation in the Portuguese economy and pushes both regions into economic recession, depriving households from essential goods. If the labor supply shock affects both economies, the negative income effect dominates the decreased demand effect for non-essential goods and that stagflation is a plausible scenario. In addition, our calibration scheme allows us to conclude that the asymmetric effects across economies may be due to different price rigidities between sectors and to different production structures between countries.

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Keywords: Essential goods, Non-essential goods, COVID-19, DSGE, Euro Area.

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1 Introduction

The worldwide spread of the infectious coronavirus disease (COVID-19) and the following global shut down may lead to an unconventional recession. With a significant fraction of workers sick or in quarantine, confinement policies, changes in mobility trends, the closing of borders and adjustments in the structure of demand, guaranteeing access to essential goods is crucial to avoid economic collapse. However, while the demand for healthcare and certain health-related goods has increased sharply, as well as demand for communications, food, home delivery services, the demand for certain durable products (namely, cars) and many services (such as tourism) has slipped down. In a recent opinion article, Paul Krugman (Krugman, 2020) refers to the latter as non-essentials, which are associated with services that authorities may shut down to limit human interaction and hence the spread of the disease. During this *coronacoma* period, however, a significant share of the population may lose their jobs. Countries or economic regions that depend largely on non-essential goods sectors will be especially affected, most likely depriving its households from essential goods, even if the number of infected population is low. This may be particularly relevant in highly integrated markets, such as the case of the Euro Area countries. In this work, we follow a qualitative approach, using the aggregation criterion proposed by Ramos et al. (2020), to analyze the macroeconomic consequences of a labor supply shock brought about by a quarantine decision across Euro Area countries. Our objective is to find answers to the following questions: Will an economy with a large export non-essential goods sector be deprived of essential goods? What is the most likely macroeconomic outcome for the Euro Area countries facing a combination of a negative demand shock in the non-essential goods sectors and a negative labor supply shock? Are there significant differences if the shocks hit economies with distinct magnitudes?

In order to answer these questions, we build a two-country, two-sector, dynamic stochastic general equilibrium (DSGE) model of a monetary union. We include health status within the household utility function, which depends on leisure hours. Households derive utility from consumption and health status, aggregating their consumption between essentials and non-essentials goods. The occurrence of an infectious outbreak, such as the COVID-19, assumed to be exogenous, will be reflected in the time devoted to leisure due to confinement measures, allowing households to increase their health status. A gain of health will change the consumption pattern between essential and non-essential goods because contact-intensive activities become unavailable. Firms produce essential and non-essential goods, demand domestic effective labor, which depends on labor health status. Government expenditures are included in the form of demand shocks, both in essential and non-essential goods. Finally, a monetary authority targeting union-wide inflation via a Taylor rule is also included. Monetary shocks are assumed to be symmetric. We calibrate the model for the case of Portugal and the rest of the Euro Area.

Our simulations show that a labor supply shock hitting the rest of the Euro Area will spread to the Portuguese economy, leading to a decline in the output growth and a period of high inflation, depriving households from access to essential goods. We also show that the income effect of a labor supply shock affecting the whole Euro Area dominates the decline in demand for non-essential goods, drawing stagflation as a plausible scenario.

In Section 2 we present the recent literature on the macroeconomic effects of the COVID-19. Section 3 we sets up the model. Section 4 reports the calibration scheme employed and a discussion on the aggregation between essential and non-essential goods. In Section 5, we show the simulations of the shocks. Section 6 concludes.

2 Related Literature

A significant stream of literature has appeared and is still growing on the macroeconomic effects of the infectious disease coronavirus (COVID-19) outbreak. Guerrieri et al. (2020) show that pandemic-driven labor supply shocks can cause demand spillovers via intra-temporal effects under certain parameterizations of the elasticities of substitution. In their framework, the demand is endogenous and affected only by the labor supply shock, in a multiple-sector environment with low substitutability across sectors and incomplete markets, with liquidity constrained consumers. In our work, we model the labor supply shocks similarly, but the spillover effects are transmitted via an health status function affecting the consumption of certain (non-essential) goods. Fornaro and Wolf (2020) employ a small-scale New Keynesian model to show that a negative supply shock may depress aggregate demand through persistent effects on productivity growth. This is what the authors label as a supply-demand doom loop, which amplifies the initial supply shock on labor, opening the door to self-fulfilling pessimistic expectations, pushing the economy into a stagnation strap. We also take a more qualitative approach but focus on international trade, unlike any of the works above. It is also our intention to analyze the impact of the pandemic on highly integrated markets with a myriad of confinement measures at different stages in the intensity of the virus, such as the case of the Euro Area. Baqaee and Farhi (2020) study the effects of the COVID-19 crisis in a multiple sector Keynesian model, with input-output interactions, calibrated for the U.S. economy. They find that negative supply shocks are stagflationary and demand shocks are deflationary. Brinca et al. (2020) estimate a Bayesian Structural Vector Autoregressive (SVAR) model on growth rates of hours worked and real wages during the COVID-19 period in the U.S. economy to decompose sectoral outcomes into labor-demand and supply sources. The authors find that the largest share of the decline in hours worked can be attributed to labor-supply shocks but there is considerable heterogeneity across sectors, with Leisure and Hospitality being among the most affected ones. Ramos et al. (2020), using the World Input-Output database (WIOD), aggregate goods into essential and non-essential sectors, which serves as the basis for the production structure in our model, to show that a symmetric exogenous ad-hoc demand shock to the non-essentials goods sector has asymmetric effects across countries. They argue that the change in the global consumption pattern brought about by the pandemic will have a greater impact in China, Indonesia and Malta, as measured by the Gross Value Added (GVA). Their estimates point to a 33.1% drop in global trade, and a significant deterioration in the balance of payments in some countries such as Luxembourg, Czech Republic, Taiwan and South Korea.

A burgeoning body of work, motivated by the COVID-19 pandemic, make contact with epidemiological models of contagion, integrating them into an economic framework.

Alvarez et al. (2020) use the Susceptible, Infectious or Recovered (SIR) epidemiology model to analyze the intensity and duration of an optimal lockdown policy. Atkenson (2020) provides a useful overview of the SIR model and a series of simulations for the progression of COVID-19. In the model of Eichenbaum et al. (2020), people react endogenously to epidemic exposure risk by reducing their labor supply and consumption goods, in a real one-sector environment. These effects work together to generate a large, persistent recession. A trade-off between the severity of the recession and the health consequences of the pandemic is established. In contrast, Krueger et al. (2020), by extending the previous model with multiple heterogeneous sectors that differ in their infectious probabilities, show that the economic slump can be mitigated or even avoided due to smooth and quick transitions in the labor markets, where workers re-allocate to the (new) sectors in demand, while keeping the COVID-19 spread low.

3 The model

The literature on DSGE models, and particularly for modeling a monetary union, is vast. After the seminal work of Smets and Wouters (2003) for the case of the European Monetary Union, a plethora of papers has followed. Without being extensive, some examples in the literature are Fagan et al. (2005), Adolfson et al. (2007), Ratto et al. (2009), Rabanal (2009) or Quint and Rabanal (2014). The model we propose shares many characteristics of these models. Our modest contribution to this large literature consists on a two-country model featuring tradable essentials and tradable non-essentials sectors. To the best of our knowledge, this is the first DSGE model with such framework. We also departure from the consideration of a small open economy model, allowing for the calibration of any two-sized economies, under the same veil as Rabanal (2009) and Quint and Rabanal (2014).

3.1 Households

Consider a monetary union composed of two countries, home (H) and foreign (F), populated by a continuum of households and a continuum of firms, with sizes s and $(1-s)$, respectively. The representative household is indexed by $h \in [0,1]$ in the home economy and by $h^* \in [0,1]$ in the foreign economy.[3] Following the functional form in Hall and Jones (2007) and Yagihashi and Du (2015), household members derive utility from consumption and health status in order to maximize expected lifetime utility. The maximization problem is subject to a budget constraint, with revenues coming from labor income, returns on a single, one-period, riskless, union-wide bond, denominated in euros, and dividends from ownership of firms. The optimality condition for the representative household's inter-temporal decision yields the standard Euler equation,[4]

$$\mu_t = E_t \left[\mu_{t+1} + r_t - \pi_{t+1}\right] \tag{1}$$

where μ_t denotes the marginal utility of consumption given by, $\mu_t = -\sigma c_t(h)/(1-b)$. $\sigma > 0$ governs the inter-temporal elasticity of substitution for consumption and b is the conventional exogenous habit formation parameter. $\pi_t = p_t - p_{t-1}$ is the Consumer Price Inflation (CPI) rate and r_t the nominal interest rate.

For simplicity, we assume that health status (h_t) is only related with leisure hours $(1-l_t)$, such that,

$$h_t = \kappa(1-l_t) \tag{2}$$

where κ denotes the elasticity of substitution of health with respect to leisure hours and l_t the (normalized) time spent working. The first order condition for leisure is given by,

$$[\kappa(1-\phi)-1](1-l_t) = \mu_t + w_t + x_t \tag{3}$$

[3]The foreign economy is denoted with an asterisk as a counterpart of the same variable in the domestic economy.

[4]Throughout all the variables are presented in percentage deviations from the non-stochastic steady state.

where ϕ denotes the inverse of the inter-temporal elasticity of substitution for health status and w_t is the nominal wage. x_t is an exogenous disturbance to the utility weight of health status affecting the intra-temporal preferences of households and follows a univariate AR(1) representation in log-linear form:

$$x_t = \rho_x x_{t-1} + \varepsilon_{x,t} + \varepsilon_t \tag{4}$$

where $\rho_x \in [0, 1]$, augmented with a union-wide shock, ε_t.[5] A shock to either $\varepsilon_{x,t}$ or ε_t increases leisure time, which is how households obtain health in our framework, ultimately reducing the supply of labor.[6]

The consumption index (c_t) is defined as a constant elasticity of substitution (CES) aggregate of essential ($c_{E,t}$) and non-essential ($\tilde{c}_{N,t}$) goods indexes. Optimal demand for consumption from each sector can be written as downward sloping functions of relative sector prices:

$$c_{E,t} = -\epsilon_c(p_{E,t} - p_t) + c_t \tag{5}$$

$$\tilde{c}_{N,t} = -\epsilon_c(p_{N,t} - p_t) + c_t. \tag{6}$$

The parameter $\epsilon_c > 0$ denotes the elasticity of substitution between sectors. We link the consumption of non-essential goods with health status in the following way:

$$\tilde{c}_{N,t} = c_{N,t} + \xi h_t \tag{7}$$

where ξ denotes the elasticity of non-essential goods consumption with respect to the health status. Note that, in the steady-state (normal times), we have $h_t = 0$ and $\tilde{c}_{N,t} = c_{N,t}$.

Quantities in (5) and (6) are combinations of domestically produced and imported

[5]The analogous disturbance for the foreign economy evolve as follows: $x_t^* = \rho_x^* x_{t-1}^* + \varepsilon_{x,t}^* + \varepsilon_t$.

[6]Similar results can be obtained with a disturbance to the disutility of work (Hall, 1997) in a more conventional approach. As noted by Justiniano et al. (2013), this intra-temporal preference or labor supply shock enters in the household's first order conditions for the optimal supply of labor as a wage mark-up shock in a model with staggering wages.

goods in a CES nested structured. Let $p_{Hk,t}$ and $p_{Fk,t}$ denote sector $k \in [E, N]$ domestic and imported prices, respectively. Optimal demand for domestically produced consumption ($c_{Hk,t}$) and for imported goods ($c_{Fk,t}$), from each sector, can be written as follows:

$$c_{HE,t} = -\nu(p_{HE,t} - p_{E,t}) + c_{E,t} \tag{8}$$

$$c_{HN,t} = -\nu(p_{HN,t} - p_{N,t}) + c_{N,t} \tag{9}$$

$$c_{FE,t} = -\nu(p_{FE,t} - p_{E,t}) + c_{E,t} \tag{10}$$

$$c_{FN,t} = -\nu(p_{FN,t} - p_{N,t}) + c_{N,t} \tag{11}$$

where $\nu > 0$ governs the elasticity of substitution between goods from different countries. Therefore, households substitute their demands towards goods from countries with relatively low prices. Since $\tilde{c}_{N,t}$ depends on $c_{N,t}$, changes in the health status will affect the consumption of domestic and imported non-essential goods.

There are a few points worth noting. First, the occurrence of an infectious disease outbreak (such as the COVID-19) is captured in our model as an increase in leisure time (or a decrease in hours worked) due to quarantine or lockdown policies [Equation (3)]. This allows households to increase their health status [Equation (2)]. Second, while stay-at-policies have a direct effect on health status, some contact-intensive sectors will face a shrinkage in the demand as a consequence [Equation (7)]. We label these sectors as non-essential. Third, our framework doesn't allow for the distinction between supply and demand shocks, in so far as we couple these two effects under the same shock. However, this has the advantage of describing the potential consequences of a society-wide pandemic using a single shock.

3.2 Firms

There is a continuum of monopolistic competitive firms in each sector $k \in (E, N)$. Brands of essential (E) and non-essential goods (N) are indexed by $f_k \in [0, s_k]$ in the domestic country and by $f_k^* \in (s_k, 1]$ in the foreign country. Each firm j in sector k uses labor, $l_{k,t}$, as the only input. Aggregate output in domestic sector can be written as,

$$y_{E,t} = z_{E,t} + l_{E,t} \tag{12}$$

$$y_{N,t} = z_{N,t} + l_{N,t} \tag{13}$$

where $z_{E,t}$ and $z_{N,t}$ are stationary sector-specific productivity shocks, that is:

$$z_{E,t} = \rho_{ZE} z_{E,t-1} + \varepsilon_{EZ,t} \tag{14}$$

$$z_{N,t} = \rho_{ZN} z_{N,t-1} + \varepsilon_{NZ,t} \tag{15}$$

Price setting by domestic and foreign firms is subject to monopoly supply power and sticky prices. In particular, firms set prices *a la* Calvo (1983) and Yun (1996). Let $(1 - \theta_k)$ denote the probability that randomly selected domestic firms get to post new prices in sector k. The fraction $\phi_k \in [0, 1]$ of remaining firms indexes its price to last period's sectoral inflation rate. The optimality conditions imply the following domestic New Keynesian Phillips curves (NKFCs):

$$(1 + \phi_E \beta)\pi_{E,t} = \phi_E \pi_{E,t-1} + \beta \pi_{E,t+1} + \frac{(1 - \theta_E)(1 - \beta\theta_E)}{\theta_E}(\bar{E}_t - z_{E,t} - p_{HE,t} + p_t) \tag{16}$$

$$(1 + \phi_N \beta)\pi_{N,t} = \phi_N \pi_{N,t-1} + \beta \pi_{N,t+1} + \frac{(1 - \theta_N)(1 - \beta\theta_N)}{\theta_N}(\bar{N}_t - z_{N,t} - p_{HN,t} + p_t) \tag{17}$$

where the real wage is defined as $\bar{w}_t = w_t - p_t$ and β denotes the household's discount factor.

3.3 Aggregation, fiscal policy and risk sharing

Goods produced in each sector k are consumed by domestic households, exported or purchased by the government, that is,

$$y_{E,t} = (1-\gamma_G)[\gamma_{HE}c_{HE,t} + (1-\gamma_{HE})c^*_{HE,t}] + \gamma_G g_{E,t} \tag{18}$$

$$y_{N,t} = (1-\gamma_G)[\gamma_{HN}c_{HN,t} + (1-\gamma_{HN})c^*_{HN,t}] + \gamma_G g_{N,t} \tag{19}$$

where γ_G is defined as the steady state ratio of government expenditures over output and γ_{HE} (γ_{HN}) denote the share of home produced essential (non-essential) goods in the domestic basket. Government expenditures $g_{E,t}$ ($g_{N,t}$), consisting on essentials (non-essential) goods, assumed to be fully financed by lump-sum taxes in order to ensure balanced growth, are modeled as exogenous shocks, according to

$$g_{E,t} = \rho_{GE}g_{E,t-1} + \varepsilon_{GE,t}. \tag{20}$$

$$g_{N,t} = \rho_{GN}g_{N,t-1} + \varepsilon_{GN,t}. \tag{21}$$

Using the appropriate prices indexes we are then able to write the aggregate real GDP equation:

$$\bar{y}_t = \gamma_E(y_{E,t} + p_{E,t} - p_t) + (1-\gamma_E)(y_{N,t} + p_{N,t} - p_t) \tag{22}$$

such that γ_E denotes the steady state weight of essential goods in the domestic consumption basket.

The single, one-period, risk-less bond, implies the perfect risk sharing condition (Chari et al., 2002). Thus, Euler equations between home and foreign households can be combined to obtain the following expression for the real exchange rate:

$$rer_t = p^*_t - p_t = \mu^*_t - \mu_t. \tag{23}$$

Equation (23) establishes the relationship between the real exchange rate and the marginal rates of substitution and shows that, in the absence of nominal exchange rate fluctuations between the two economies, changes in the real exchange rate are due to inflation differentials, such that, $\Delta rer_t = {\pi_t}^* - \pi_t$.

3.4 Monetary policy

The model is closed with a specification for the monetary authorities. Following the usual approach in the DSGE literature, see e.g. Smets and Wouters (2003); Gali and Monacelli (2005), we assume that monetary policy can be approximated by a Taylor rule of the form:

$$r_t = \rho_r r_{t-1} + (1-\rho_r)(\gamma_\pi \pi_{MU,t} + \gamma_Y \bar{y}_{MU,t}) + \varepsilon_{m,t} \tag{24}$$

where ρ_r, γ_π and γ_Y are policy coefficient and ε_t^m is an iid monetary policy shock. With this setting, a single monetary authority targets both union-wide inflation ($\pi_{MU,t}$) and real output ($\bar{y}_{MU,t}$). These are aggregated according to

$$\pi_{MU,t} = s\pi_t + (1-s)\pi_t^* \tag{25}$$

$$\bar{y}_{MU,t} = s\bar{y}_t + (1-s)\bar{y}_t^*. \tag{26}$$

After calibrating shares γ_E, γ_{HE}, γ_{HN}, γ_G and their foreign counterparts we are able to obtain endogenously the sizes of each economy, s and $(1-s)$.

4 Calibration

The model is calibrated for Portugal and the rest of the Euro Area. For simplicity, we establish a set of common parameters and a set of country-specific parameters. The calibration scheme is shown in Table 1. Following Smets and Wouters (2003), the discount factor is set to 0.992 and the habit formation parameter to 0.6. Regarding σ, the value of 1 imposes a logarithmic preference specification on consumption. We set the elasticity of substitution between health and leisure hours at 0.7, an higher value than that used in Yagihashi and Du (2015).[7] The elasticity between the consumption of non-essential goods and health status is set at 0.8, reflecting that the demand for this type of goods depends greatly on the health status of households.

[7] We adjust the steady state such that $h_t = 0$, which implies $\tilde{c}_{N,t} = c_{N,t}$.

[Table 1 about here]

Taylor rule parameters are set at conventional values (Smets and Wouters, 2003), with a long-run response to inflation of $\gamma_\pi = 1.5$ and with a long-run response to the output gap of $\gamma_Y = 0.5$. The coefficient on the lagged interest rate, i.e., interest rate smoothing, is set to $\rho_r = 0.85$.

We had no *a priori* indication about any of the parameters regarding essential and non-essential goods. Our assumption was that the elasticity of substitution between these goods and between domestic and imported goods are constant and equal across economies. We set the elasticity of substitution between the two goods and between domestic and imported goods to $\epsilon_c, \epsilon_c^* = 0.5$ and $\nu, \nu^* = 1.5$, respectively, following Atalay (2017) and Rabanal (2009), which are quite common values in the literature.

Only calvo prices and price indexation coefficients are assumed to differ between sectors and countries. Our strategy was as follows: i) Euro Area prices are less stickier than those in Portugal; ii) Firms in the non-essential sectors are allowed to adjust prices faster; iii) The degree of price indexation is the same between sectors but higher in the Portuguese economy. In all cases, prices are reset optimally in less than 4 periods and the degree of backward-looking in the Phillips curves is between 0.45 and 0.4.

In order to determine the shares of essential goods in the consumption baskets we relied on the World Input-Output Database (WIOD). According to Ramos et al. (2020)[8], non-essentials are broadly composed by Manufacture, Construction, Transport (by water and by air) services, Accommodation and food service activities, Art, Accounting, Legal, Architectural and Advertising related sectors. The description of each sector in this category is reported in the footnote of Table 1 using the WIOD nomenclature. As can be observed, the share of essential goods is higher in the Euro Area when compared to that of Portuguese consumers. In both cases, essential goods are more than 54% of total

[8]We thank the authors for their commentaries and suggestions regarding the aggregation procedure, in particular João Pedro Ferreira for his guidance using the WIOD. All the errors are our own.

consumption. Portugal's share of domestic essential and non-essential goods is higher than 80%, supporting the home bias postulate, and greater for the former. Euro Area non-essential goods imports reach 2%, showing the relative importance of these sectors, such as tourism activities, in the Portuguese exports structure. Therefore, a negative demand shock towards non-essential goods may have an important impact in Portugal's exports.

5 Simulations

We consider two extreme scenarios in our simulations. In the first one, we examine a shock to the labor supply affecting only rest of the Euro Area. In this case, we assume the implausible scenario that Portuguese authorities wouldn't take any quarantine or lockdown measures affecting the supply of labor. In the second scenario, the labor supply shock hits both economies with the same magnitude, a situation which one may label as a union-wide full lockdown.

Figure 1 depicts the first scenario. This type of shock is analogous to an intra-temporal preference shock, shifting the foreign labor supply curve in for both sectors. As a consequence, hours worked decline in the essentials and non-essentials sectors, driving wages up on impact. Since firms' marginal costs increase, prices increase also. Foreign consumption falls (in an hump-shaped form due to habit persistance) since households' income declines. Health status increases in rest of the Euro Area but by less than the increase in leisure time given our choice for the elasticity of substitution. The increase in health status amplifies the decline in the consumption of non-essentials goods. As a result of lower employment and decreased demand, output growth in the rest of the Euro Area declines sharply. One important thing to note is that the supply side shock dominates the decline in demand, leaving the economy in a stagflationary scenario. However, since firms in the non-essential sector adjust prices faster, essential goods consumption increases on impact and it's partly directed to Portuguese exports.

[Figure 1 about here]

The effects of the lockdown are also conveyed to the Portuguese economy. Since Euro Area imports become relatively more expensive and exports relatively cheaper, the demand for domestic goods increases at the outset, leading to a decline in leisure hours, which has an impact in the domestic health status, and hence increased exposure to the infection, reinforcing the demand for non-essential goods. Firms adjust their prices up, albeit sluggishly, without loosing market share in both markets. The economy enjoys a brief period of output growth until the effects of declining demand materialize. As can be observed, the shock in the foreign economy is transmitted to Portugal since markets are fully integrated. Firms are able to maintain their prices above trend and households are deprived of essential goods because of higher price stickiness.

[Figure 2 about here]

Figure 2 shows the impulse response function to a shock to ε_t, a situation where the shock to labor supply affects both economies. The transmission mechanisms are similar to those described above. There are, however, a few differences worth mentioning. First, consumption of essential goods is lower in both economies on impact. This is explained by the fact that prices are stickier in this sector. Second, output growth declines more in the rest of the Euro Area since firms adjust prices faster, but we observe a longer recession in Portugal. Third, our findings suggests that both economies may be pushed into a period of stagflation.

6 Conclusion

In this work we conduct a qualitative assessment on the macroeconomic effects of a labor supply shock in the Euro Area through the lens of a dynamic stochastic general equilibrium model. We propose a variation on the usual formulation of these models by incorporating essential and non-essential goods, in an environment where a labor supply shock affects the health status of households, which, in turn, is linked to the demand of non-essential goods. We calibrate the model for Portugal and the rest of the Euro Area and present simulations for two distinct scenarios. Our findings show that a labor supply shock affecting only the rest of the Euro Area is able to generate inflation in the Portuguese economy due to households' substitution effects. This follows with an increase in hours worked and an increasing risk of infections (as read by health status). The positive output growth on impact precedes an economic recession as demand declines in both countries. Households are then deprived of essential goods partly because firms keep satisfying foreign demand and partly due to price stickiness. Once we consider a union-wide labor supply shock, we are able to show that the income effect dominates the demand shortage in the non-essential goods sector and that a staflationary scenario is a plausible one.

We strongly believe that our results are relevant from a macroeconomic policy point of view. The prospect of stagflation poses a laborious task for governments and the monetary authority, and highlights the urge for policy coordination among countries sharing the common currency. Upward pressure on prices in some essential goods, reinforced by hoarding behavior, may demand government intervention in order to avoid supply chains disruptions and ensure that those who have lost their jobs have access to these goods. Countries with a more non-essential oriented economic structure will be more affected. Workers can't go to work, sales are close to zero and firms won't be able to pay wages and taxes. As a result, the demand for loans will rise. All over the European Union, several national governments already opened credit lines to support companies, thus providing short-term liquidity and circumvent mass lay-offs and defaults. The response, however, must be faster, assertive and wider. Union-wide measures are critical to fight a common shock to ensure the political survival of the European Union in one of the most dark periods of its history. These are times that require crossing a political Rubicon, in which member states must commit to share the burden of the fiscal response.

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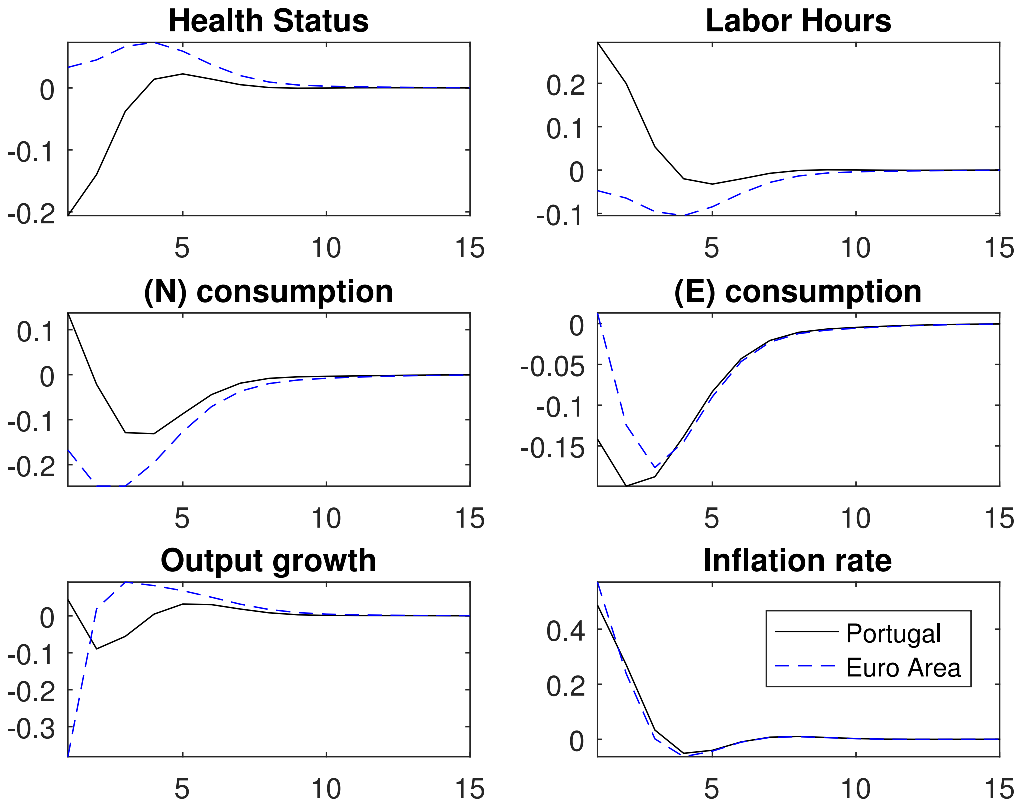
7 Appendix

Table 1: Calibration scheme

Country	Parameter	Description	Value
Common	β, β^*	Time discount factor	0.992
	b, b^*	Habit formation	0.6
	σ, σ^*	Inter-temporal elasticity of substitution (consumption)	1
	ϕ, ϕ^*	Inter-temporal elasticity of substitution (health status)	2
	κ, κ^*	Elasticity of substitution between health and leisure hours	0.7
	ξ, ξ^*	Elasticity of N goods consumption w.r.t. health	0.8
	ϵ_c, ϵ_c^*	Elasticity of substitution between E and N goods	0.5
	ν, ν^*	Elasticity of substitution between domestic and imported goods	1.5
	ρ_r	Interest rate smoothing coefficient; Taylor rule	0.85
	γ_π	Response to inflation; Taylor rule	1.5
	γ_Y	Response to output; Taylor rule	0.5
Portugal	γ_E	Share of E goods in domestic consumption	0.549
	γ_{HE}	Share of home E goods in domestic consumption	0.883
	γ_{HN}	Share of home N goods in domestic consumption	0.829
	γ_G	Domestic government expenditures ratio	0.19
	θ_E	Calvo prices (E)	0.65
	θ_N	Calvo prices (N)	0.35
	ϕ_E	Price indexation (E)	0.45
	ϕ_N	Price indexation (N)	0.45
Euro Area	γ_E^*	Share of E goods in foreign consumption	0.557
	γ_{HE}^*	Share of foreign E goods in foreign consumption	0.999
	γ_{HN}^*	Share of foreign N goods in foreign consumption	0.998
	γ_G^*	Domestic government expenditures ratio	0.21
	θ_E^*	Calvo prices (E)	0.6
	θ_N^*	Calvo prices (N)	0.3
	ϕ_E^*	Price indexation (E)	0.4
	ϕ_N^*	Price indexation (N)	0.4

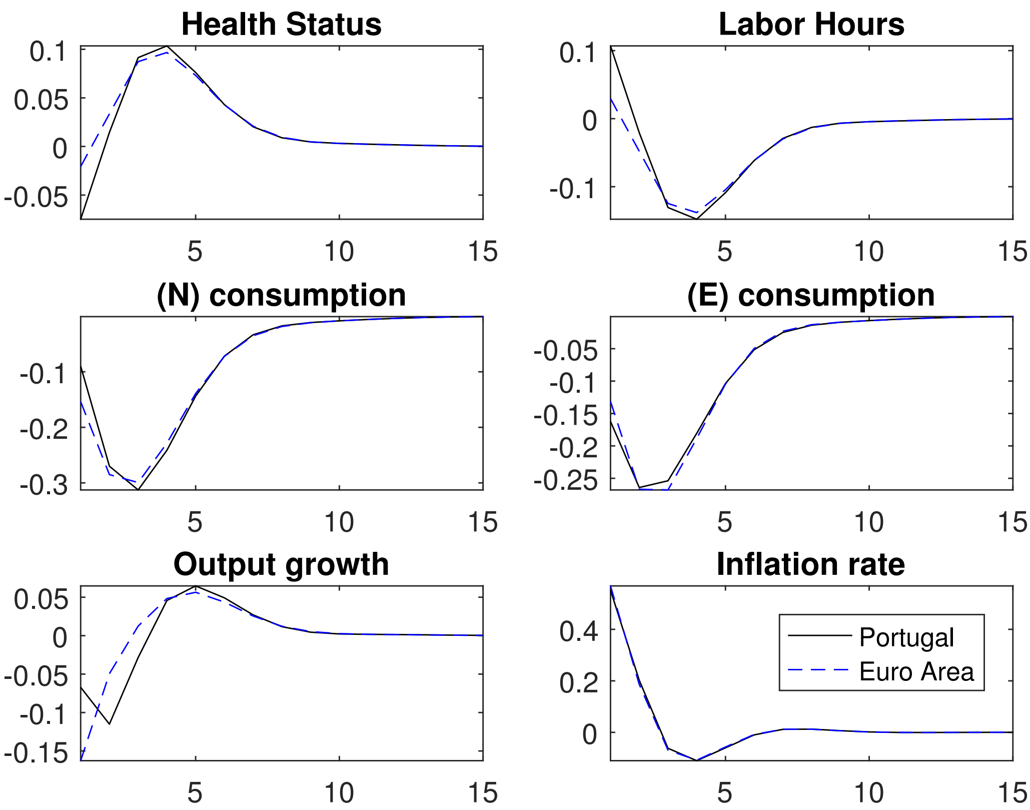
Notes: Essentials and non-essentials shares are calculated using the World Input-Output Database (WIOD). Non-essentials include sectors: B, C13-C18, C20, C22-C25, C27-C32, F, G45-G47, H50-H52, I, J58-J60, M69-M71, M73-M75, R-S and T. Own calculations.

Figure 1: Impulse response functions to a labor supply shock in the rest of the Euro Area



Notes: The figure shows the impulse responses to a 1% shock to $\varepsilon^*_{x,t}$ (in percent deviations from the steady state). The persistence parameters are set at $\rho_x = \rho^*_x = 0.6$. Own calculations.

Figure 2: Impulse responses functions to a union-wide labor supply shock



Notes: The figure shows the impulse responses to a 1% shock to ε_t (in percent deviations from the steady state). The persistence parameters are set at $\rho_x = \rho_x^* = 0.6$. Own calculations.