This paper estimates the stabilizing effects of tax and transfers systems through a marginal incentives channel. When income taxes are progressive, the tax rate that a household faces will fall following an income decline in a recession, thereby increasing work incentives and hence labor supply. This effect offsets part of the initial income decline, stabilizing aggregate income and output. The magnitude of the effect depends on the change in the marginal tax rate after a change in gross income, as well as the elasticity of labor supply with respect to a change in the after-tax wage.

We estimate a structural discrete choice labor supply model and individual tax rates for households in the EU28 using the microsimulation model EUROMOD and EU-SILC household data. Our estimations show that up to ten percent of a fall in household income is offset by an increase in labor supply. The EU average is roughly two percent. The results reveal a large heterogeneity across countries, which is mainly due to differences in the progressivity of the tax systems across Europe: the incentive effect is large in countries with a highly progressive tax schedule, while it is zero for countries with a flat tax, where the marginal tax rate is constant. Differences in labor supply elasticities also play a significant role.

\textit{JEL classification:} H31, H24, C25, H12
\textit{Keywords:} Stabilization; Household Labor Supply; Elasticity; Income insurance;
1 Introduction

Tax and transfer systems redistribute incomes across households. They also serve as Automatic Stabilizers, providing insurance against income fluctuations over the business cycle. By Automatic Stabilizers we mean those elements of the tax and transfer system that mitigate fluctuations in output without discretionary government action (Dolls et al., 2012b).

This paper estimates the stabilizing effects of tax and transfers systems through a marginal incentives channel. When income taxes are progressive, the tax rate that a household faces will fall following an income decline in a recession, thereby increasing work incentives and hence labor supply (Christiano, 1984). This effect offsets part of the initial income decline, stabilizing aggregate income and output. The magnitude of the effect depends on the change in the marginal tax rate after a change in gross income, as well as the elasticity of labor supply with respect to a change in the after-tax wage.

In general, the stabilizing power of taxes and transfers can work through four channels (McKay and Reis, 2016):

1. Disposable Income channel
2. Marginal Incentives channel
3. Redistribution Channel
4. Social Insurance Channel

The disposable income channel works through a mechanical effect of the tax system to absorb fluctuations in gross income, which stabilizes aggregate demand through the stabilizing effect on disposable income (Pechman, 1973; Auerbach and Feenberg, 2000; Dolls et al., 2012b). In the presence of nominal rigidities, this stabilization of aggregate demand will stabilize output. The marginal incentives channel works through the change in the marginal tax rate when a household is subject to an income shock. In a progressive tax system this will lead to an increase in work incentives, which increases labor supply. The redistribution channel takes into account that receivers of transfers may have higher propensities to spend out of their income, which leads to the stabilization of aggregate demand. Through the social insurance channel, automatic stabilizers influence precautionary savings. In particular, they might reduce savings to the point that households encounter liquidity constraints after they face a shock.

Contribution This paper focuses on the marginal incentives channel. We estimate labor supply elasticities for households in the EU27, as well as the responsiveness of the tax and transfer system. In particular, we estimate the change of the marginal tax rate with respect to a percentage change in the gross income. The marginal tax itself gives an indication of the tax system’s automatic stabilization capacity according to the disposable incomes channel (Pechman, 1973; Auerbach and Feenberg, 2000; Dolls et al., 2012b). When households face a sudden and temporary income decline, they may temporarily be subject to a lower marginal tax rate. This

\[\text{Due to data constraints, Croatia is the only EU member state that is not included.}\]
triggers an intertemporal substitution of labor. The magnitude of this effect is mainly driven by the change in the marginal tax rate that follows the income shock, and the elasticity of labor supply with respect to the net wage.

Our first contribution is the estimation of labor supply elasticities in a consistent manner for a large set of countries. We use a compelling methodology that allows to compare labor supply elasticities consistently across countries. Secondly, we contribute to the literature that assesses the incentive effects of the tax system by providing estimates of effective marginal tax rates and the progressivity of the tax and transfer system (see Auerbach and Feenberg, 2000; Saez, 2002; Immervoll et al., 2007; Wallenius, 2013). Thirdly, we contribute an estimate of the Automatic Stabilization effect that operates through the marginal incentives channel.


2 Estimation

We estimate a structural discrete choice labor supply model as in Bargain et al. (2014) for households and individuals to analyze the behavioral response to changes in wages. We estimate effective marginal tax rates using the microsimulation model EUROMOD and EU-SILC household data.

2.1 Discrete Choice Methodology

Underlying the analysis in this paper is a discrete hours labor supply model to estimate the effect of a behavioral response to a wage change. We assume households to maximize utility while facing the standard consumption-leisure trade-off. In particular, we estimate utility functions that give a distribution of choice probabilities (see McFadden, 1973). Utility consists of a deterministic part, which is a function of observable variables, and an error term that reflects optimization errors, measurement error, or unobserved characteristics. For the deterministic part we specify a utility function that depends on both household characteristics and characteristics of the hours category (most notably the associated work and leisure times and the disposable income from working the respective amount of time, but also fix costs of taking up work). By letting household characteristics enter the utility function, we allow for observed heterogeneity in household preferences. Household characteristics also influence how gross income translates into disposable income the the tax-benefit-function. Disposable income is a function of household earnings, non-labor income, and household characteristics (e.g. age, marital status, number of kids). We use the European Union Statistics on Income and Living Conditions (EU-SILC) for household incomes and demographics, and the microsimulation model EUROMOD to calculate direct taxes, social insurance contributions and received benefits to obtain disposable incomes.
The estimation is implemented as Maximum Likelihood estimation. As is standard in the literature, we estimate single men, single women, and couples separately. Married couples are assumed to maximize a joint utility function, which means that each combination of the two partners’ hours is a distinct category (resulting in 16 categories for couples, compared to 4 for singles).

2.2 Econometric Model and Identification

We estimate a discrete choice model as in Aaberge et al. (1995); van Soest (1995); Bargain et al. (2014).\(^2\) We specify quadratic\(^3\) utility function with fixed costs of work as the deterministic part of the utility function:

\[
U_{ij} = \alpha_{ci} C_{ij} + \alpha_{cc} C_{ij}^2 + \alpha_{hfi} H_{ij}^f + \alpha_{hm} H_{ij}^m + \alpha_{hj} (H_{ij}^f)^2 + \alpha_{hm} (H_{ij}^m)^2 + \alpha_{cij} H_{ij}^f + \alpha_{chm} C_{ij} H_{ij}^m + \alpha_{hm} H_{ij}^f H_{ij}^m - \eta_{f} \cdot 1(H_{ij}^f > 0) - \eta_{m} \cdot 1(H_{ij}^m > 0)
\]

with household consumption \(C_{ij}\) and partners’ hours of work \(H_{ij}^f\) and \(H_{ij}^m\). The \(J\) choices for a couple correspond to all combinations of the spouses’ discrete hours (for singles, the model above is simplified to only one hour term \(H_{ij}\), and \(J\) is simply the number of discrete hour choices for this person). Coefficients on consumption and work hours are specified as:

\[
\alpha_{ci} = \alpha_{c}^0 + Z_{i} \alpha_{c} + u_i
\]

\[
\alpha_{hfi} = \alpha_{h}^0 + Z_{i} \alpha_{h}\]

\[
\alpha_{hm} = \alpha_{h}^m + Z_{i} \alpha_{hm},
\]

i.e. they vary linearly with observable taste-shifters \(Z_{i}\) (including polynomial form of age, presence of children or dependent elderly persons and dummies for education). The term \(\alpha_{ci}\) can incorporate unobserved heterogeneity, in the form of a normally-distributed term \(u_i\), for the model to allow random taste variation and unrestricted substitution patterns between alternatives.\(^4\)

We include fixed costs of work into the model that help explain that there are very few observations with a small positive number of hours worked. These costs, denoted by \(\eta_{k}\) for \(k = f, m\), are non-zero for positive hours choices.\(^5\)

In general, the approach is flexible and allows to impose few constraints (see Bargain et al., 2014; van Soest, 1995). One restriction sometimes taken in the literature is to require the utility function to be monotonically increasing in consumption, as it can be seen as a minimum consistency requirement of the econometric model with economic theory. When the fraction

\(^2\)Other contributions include Blundell et al. (2000) for Europe and Hoyes (1996); Michael Keane (1998) for the US.

\(^3\)Other common specifications include log or translog utility. Löfler et al. (2014) show that the choice of the functional form is not a significant driver of labor supply elasticities.

\(^4\)Formally, this makes the model a mixed logit model, which we estimate using maximum simulated likelihood (see Train, 2009).

\(^5\)Introducing fixed costs of work, estimated as model parameters as in Bargain et al. (2014), Callan et al. (2009) or Blundell et al. (2000), improves the fit of the model.
of observations with an implied negative marginal utility of consumption is more than 5%, we impose positive marginal utility as a constraint in the likelihood function.\(^6\)

For each labor supply choice \(j\), disposable income is calculated as a function

\[ C_{ij} = d(w_i^f H_{ij}^f, w_i^m H_{ij}^m, y_i, X_i) \]

of female and male earnings, non-labor income \(y_i\) and household characteristics \(X_i\). We denote disposable income by the letter \(C\) to stress its equivalence with consumption. In this static setting, we do not model a savings decision of the household. The elasticities we estimate are hence Marshallian elasticities\(^7\). We argue below that this elasticity concept is appropriate to use for calibration of the elasticity in the macroeconomic model: we are interested in calibrating the intratemporal elasticity of labor supply, and not a dynamic (Frisch) elasticity that is calibrated to match labor supply fluctuations over the business cycle.

We simulate the tax-benefit function \(d\) using the tax-benefit calculator EUROMOD, which we present in the next section. Disposable income needs to be calculated at the discrete set of choices, that is, only certain points on the budget curve have to be evaluated. We obtain wage rates for individuals by dividing earnings by working hours in the choice category.\(^8\) As our sample includes individuals that are not observed to be working, we estimate a Heckman selection model for wages and use predicted wages for all observations\(^9\)

As the model is stochastic in nature, the full specification of the labor supply model is given by including i.i.d. error terms \(\epsilon_{ij}\) for each choice \(j = 1, ..., J\). That is, total utility at each alternative is

\[ V_{ij} = U_{ij} + \epsilon_{ij}, \]

with the observable part of utility \(U_{ij}\) being defined as above. The error terms can represent measurement errors or optimization errors of the household. Under the assumption that errors follow an extreme value type I (EV-I) distribution, the (conditional) probability for each household \(i\) of choosing a given alternative \(j\) has an explicit analytical solution (McFadden, 1974; Creedy and Kalb, 2006):

\[ p_{ij} = \frac{\exp(U_{ij})}{\sum_{k=1}^{J} \exp(U_{ik})}. \]

**Identification** As the tax-benefit calculator accounts for a rich set of policies, we make use of the variation provided by nonlinearities and discontinuities inherent in these policies. This is the usual source of variation for models estimated on cross-sectional data, that cannot rely on

\(^6\)We choose the lowest multiplier that ensures at least 95% of the observations with positive marginal utility of consumption through an iterative procedure. To speed up estimation, we refrain from estimating the model with unobserved heterogeneity in these cases, that is, we do not include an error term in the coefficient \(\alpha_i\).

\(^7\)Hicksian elasticities can be obtained by additionally estimating income elasticities and using the Slutsky decomposition.

\(^8\)We use hours normalized through rounding to the nearest hours category instead of actual hours to reduce division bias, see Bargain et al. (2014).

\(^9\)Using predicted wages for all observations further reduces selection bias (see Bargain et al., 2014). It is common practice to first estimate wage rates and then use them in a labor supply estimation, (see Creedy and Kalb, 2005, 2006; Löffler et al., 2014).

4
variation over time (see van Soest, 1995; Blundell et al., 2000; Bargain et al., 2014). Effective tax rates vary with household characteristics (such as marital status, age, family composition, virtual income, etc.). Although we include some of these characteristics in the estimated utility functions, tax-benefit rules condition on a richer variety of household characteristics (for example, detailed age of children, regional information or home-ownership status). Hence, the data provide variation in net wages that allows identification of the econometric model.

**Elasticities**  Labor supply elasticities cannot be derived analytically in our nonlinear econometric model. However, using the estimated structural utility function, we can calculate choice probabilities for varying incomes. Wage elasticities are calculated after simulating a marginal increase in the wage rate and predicting the probability distribution over the choice categories for the increased wage rate. The wage elasticity is defined as the change in expected working hours (that is, the probability-weighted average of working hours) with respect to the change in the wage rate. Similarly, we calculate expected incomes, benefits, and tax payments before and after the simulated income change.

### 3 Datasets

For the discrete choice estimation, it is necessary to calculate the disposable incomes in each respective hours category. For this, we use the European microsimulation model EUROMOD and recent data from the EU-SILC, a harmonised datasets of EU28 households that comes with it. EUROMOD will be used to compute the reformed tax-benefit policy, as well as to evaluate the required points of the households’ preference set to evaluate choice probabilities. We will use the latest available version “G3.0+” of EUROMOD for our study, which includes 2015 tax and benefit systems for 28 countries of the European Union. Using EUROMOD, we will then calculate the corresponding disposable income, that is, apply the appropriate tax rules to calculate the after-tax income and then simulate social insurance contributions as well as benefits and pensions the individual may be eligible for and add those to the after-tax income. Sutherland and Figari (2013) provide an overview of the recent version of EUROMOD.

### 3.1 Data and Selection

In this study, we focus on the EU27, excluding the most recent EU member state Croatia for data availability reasons. The datasets we use are based on the EU Study on Income and Living Conditions (EU-SILC), a harmonized European household survey. They have been further harmonized within the EUROMOD project, to ensure similar income concepts are used together with comparable variable definitions (e.g. for education). EUROMOD (see Sutherland, 2007) is a tax-benefit calculator, intended to provide a framework to simulate direct taxes, social insurance contributions, and social and family transfers. We use data with an income reference year of 2011, so we use the tax-benefit system of 2011 for the simulation of taxes and transfers. For each discrete choice category $j$ and each household $i$, disposable income $C_{ij}$ is calculated by aggregating all sources of household income, adding received benefits (family and social transfers),
while subtracting direct taxes (on labor and capital income) and social security contributions. We denote these tax-benefit calculations by function \( d() \) as defined above. In practice, this calculation is done by EUROMOD, based on the information on income and socio-demographic characteristics \( X_i \), as is available in the EUROMOD version of EU-SILC.

For the purpose of the labor supply estimation, we divide the base sample into three subsamples for each country, depending on the household type: we estimate the utility functions for couples, single men and single women (the latter two including single parents) separately. We restrict each estimation sample to adults aged between 18 and 60 that are available to take part flexibly in the labor market, thereby excluding disabled or retired people, those in education, self-employed, or farmers.\(^{10}\)

### 4 Stabilization Framework

This section describes the framework we use to measure automatic stabilizers. Section 4.1 describes the framework to measure the income stabilization coefficient (the disposable income channel). Section 4.2 describes the framework to measure the supply side stabilization effect (the marginal incentives channel).

#### 4.1 Income Stabilization

We measure the stabilization provided by a tax system as the coefficient of how a household’s tax payment (or benefit receipt) and thus, disposable income, varies with changes in the gross income. This measures the stabilization of disposable income.

The second stabilization effect is on demand for goods and services. It depends on how households adjust consumption with fluctuations in disposable income and how this change of aggregate demand changes output.\(^{11}\) McKay and Reis (2016) find the stabilization of demand effect to be small over the business cycle, and the income stabilization effect to be quantitatively more important. As our focus in this paper is on the marginal incentives channel, we do not attempt to measure the demand stabilization coefficient (as in Auerbach and Feenberg, 2000; Dolls et al., 2012b).

We follow Auerbach and Feenberg (2000); Dolls et al. (2012b, 2016) in calculating the response of disposable income to the change in market income.\(^{12}\) Why calculate the income stabilization coefficient in the context of the supply side stabilization coefficient? In fact, the income stabilization coefficient is closely related to the incentive measure, as it is very similar to an average effective marginal tax rate (see Dolls et al., 2012b). The change in the effective marginal tax rate is one significant driver of the marginal incentives channel, as we will see in section

\(^{10}\)For the Heckman-corrected wage estimation, we apply the same restrictions on the sample, but estimate the sample separately for women and men (that is, not separately by household types).

\(^{11}\)A large strand in the literature is concerned with estimating the consumption response to income changes. XX Cite.

\(^{12}\)This measure was originally proposed by Pechman (1973).
4.2. As a measure of income stabilization we use the “normalized tax change”, which is ratio of changes in the disposable income to changes in market income.

The mechanism behind the stabilizers is as follows. Consider a household that has to pay a proportional tax of 30 percent and faces a decline in gross income of 100 Euros. Then 30 percent of the shock would be absorbed by the proportional tax, leaving a decline of 70 Euros of disposable income. For a progressive tax system, as is in effect in the majority of the European countries, the stabilizing effect would be even larger (Dolls et al., 2012b, p. 281). Let the aforementioned household be subject to progressive taxation, and after the initial shock, her marginal tax rate would drop to 25 percent. Then this provides an additional cushioning of the decline in disposable income.

We consider a shock to market income, which is defined as

\[ Y^M_i = Y^E_i + Y^Q_i + Y^I_i + Y^P_i + Y^O_i, \]  

where \( Y^E_i, Y^Q_i, Y^I_i, Y^P_i, Y^O_i \), respectively denote labor income, business income, capital income, property income, and other income.

We define tax payments, social insurance contributions and benefit payments to be functions of market income \( Y^M_i \), of household demographic characteristics \( X_i \) that determine taxes or transfers (for instance, number of children, marital status, age), as well as the parameters of the tax and transfer system \( \chi_t \) (e.g. tax rate, bracket thresholds, deduction). We simulate the changes to income \( Y^M_i \).

Disposable income is equal to the market income minus net government intervention, which consists of direct taxes \( T(Y^M_{it}, X_i, \chi_t) \) and social insurance contributions \( S(Y^M_{it}, X_i, \chi_t) \) minus social benefits \( B(Y^M_{it}, X_i, \chi_t) \). Defining the net government intervention as \( G(Y^M_{it}, X_i, \chi_t) = T(Y^M_{it}, X_i, \chi_t) + S(Y^M_{it}, X_i, \chi_t) - B(Y^M_{it}, X_i, \chi_t) \), the disposable income is

\[ Y^D(Y^M_{it}, X_i, \chi_t) = Y^M_{it} - G(Y^M_{it}, X_i, \chi_t) \]

\[ = Y^M_{it} - \left( T(Y^M_{it}, X_i, \chi_t) + S(Y^M_{it}, X_i, \chi_t) - B(Y^M_{it}, X_i, \chi_t) \right). \]

The Income Stabilization Coefficient is denoted by \( \tau^I \) and measures how a shock on market income \( \Delta Y^M \) translates to a shock on households’ disposable income \( \Delta Y^D \):

\[ \sum_i \Delta Y^D_i = \sum_i \left( Y^D(0.95Y^M_{it}, X_i, \chi_t) - Y^D(Y^M_{it}, X_i, \chi_t) \right) = \left( 1 - \tau^I \right) \sum_i \Delta Y^M_i \]

The stabilization coefficient can be written as

\[ \sum_i \Delta Y^D_i = (1 - \tau^I) \sum_i \Delta Y^M_i \]

\[ \iff \tau^I = 1 - \frac{\sum_i \Delta Y^D_i}{\sum_i \Delta Y^M_i}. \]

Note that, for simplicity of notation, we write a dependence on market income \( Y^M_i \) only and not a dependence on each component (see equation (4.1)), although our calculations using EUROMOD respect the different income types.
can be interpreted as the fraction of a shock that is absorbed by the tax benefit system.

Using (4.2), it is possible to decompose the income stabilizer into the stabilizing effect provided by taxes, social insurance contributions and benefits. By definition, these three individual stabilizers add up to the overall income stabilizer

\[ \tau^I = \tau^I_T + \tau^I_S + \tau^I_B = \frac{\sum_i \Delta T_i}{\sum_i \Delta Y_i^M} + \frac{\sum_i \Delta S_i}{\sum_i \Delta Y_i^M} - \frac{\sum_i \Delta B_i}{\sum_i \Delta Y_i^M}. \quad (4.4) \]

### 4.2 Supply Side Stabilization

\[ \tau^s = \frac{wdt}{dY} \cdot \frac{wdL}{d[w(1-t)]} \]  

Equation (4.5) gives the general formula for the supply side stabilization coefficient. The first part is the change in the after-tax wage with respect to a change in income (keeping the before-tax wage fixed). The second part is the change in labor income with respect to a change in the after tax wage. This effect is determined by the change in labor supply.

Equation (4.5) can be rearranged to yield an equation that consists of components with a more intuitive interpretation:

\[ \tau^s = \frac{d\tau}{d\ln Y} \cdot \frac{\alpha}{1-\tau} \cdot \frac{\eta_{L,\tilde{w}}}{\text{Labor Supply Elasticity}} \]  

### 5 Results

#### 5.1 Labor Supply Elasticities

##### 5.1.1 Estimation

We estimate the labour supply elasticities separately for each country for single men, single women, and couples. We aggregate the results at individual or household level to derive an estimate for the whole population. The covariates in each estimation are the same across countries. The fit is good even with only four choices.

##### 5.1.2 Own Wage Elasticities

In figure 1 we present the results for own wage elasticities for the European countries. Generally, the elasticities are in line with the literature, ranging from 0 to around 0.6 for all countries. The labor supply elasticities are small (below 0.2) in Luxembourg, Netherlands, Cyprus, Denmark, Sweden, Hungary and the UK. We find the largest elasticities for Romania, Spain, Latvia, Belgium, Estonia, and Bulgaria (between 0.4 and 0.6). The other countries lie in a range between 0.2 and 0.4.
Intensive and Extensive Margin  We calculate intensive (hours) elasticities as the change in expected hours conditional on being observed as working in the data. Conversely, we calculate extensive (hours) elasticities as the change in expected hours conditional on being observed as not participating in the labor market. Figure 2 shows the results.

In line with the literature (see Bargain et al., 2014), we find that extensive margin elasticities are much larger than intensive elasticities, sometimes exceeding one (in Romania and Latvia). Extensive elasticities are also particularly large (approaching one) in Estonia, Lithuania, Germany and Slovakia and Malta, while we find lower extensive elasticities in Luxembourg, Sweden, Hungary, UK, Austria, Finland, Portugal and France (below 0.5). We calculate the total hours elasticity as the average of extensive and intensive margin elasticity, weighted by demographic weights. As most observations in our estimation sample are observed working, the total elasticity is close to the intensive margin elasticity.

Elasticities by Skill  Figure 3 shows elasticity results decomposed by education (skill) group. The results show a large heterogeneity across skill groups, with the consistent result that elasticities for the low skilled are larger than those for medium and high skilled, being well above 0.5 for many countries. We attribute this finding to the major role that the (high) extensive margin elasticities play at the bottom of the skill distribution.
Gross versus Net Elasticities  So far, we have looked at gross wage elasticities that we calculate as our main results. We also estimate net wage elasticities as the change in expected hours divided by the change in the net wage. Because a fraction of the change in the gross wage is dampened by the tax and transfer system, the change in the net wage will generally be less than the change in the gross wage, which is why net elasticities must be larger than their gross wage counterparts. Figure 4 plots the net wage elasticity against the gross wage elasticity. As just explained, the results should generally lie above the 45 degree line. This is always the case, except for Luxembourg. We are currently investigating the nature of this anomaly.

5.2 Incentive Effects of the Tax System

Figure 5 shows the effective marginal tax rates in the EU27, calculate as the change in taxes, transfers, and social insurance contributions with respect to a change in gross income.
5.3 Automatic Stabilizers

6 Conclusion
Figure 4: Gross vs Net Wage Elasticity

![Gross vs Net Elasticities](image)

Figure 5: Effective Marginal Tax Rates

![Marginal Tax Rates](image)
Table 1: Wage Subsample: Women

<table>
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Figure 6: Observed Marginal Tax Rates

(a) AT

(b) BE

(c) BG

(d) CY

(e) CZ

(f) DE

(g) DK

(h) EE
Marginal Tax Rate vs Gross Income for:

(i) EL
(ii) ES
(iii) FI
(iv) FR
(v) HU
(vi) IE
(vii) IT
(viii) LT

Each graph plots the marginal tax rate against gross income for different countries.
(y) SI

Marginal Tax Rate

Gross Income

(z) SK

Marginal Tax Rate

Gross Income

(aa) UK

Marginal Tax Rate

Gross Income
Figure 7: Responsiveness of Marginal Tax Rates

Responsiveness of Marginal Tax Rates

Figure 8: Supply Side Stabilization Coefficient

Labor Supply Stabilization Coefficient
Table 3: Supply Side Stabilization Coefficient

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