Automatic fiscal stabilizers in Sweden 1998–2019*

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Abstract

We use data from Sweden, a welfare state that has undertaken sizeable reforms to strengthen work incentives, to shed more light on the trade-off between policies to make work pay and the size of automatic (fiscal) stabilizers. A drawback of policies to make work pay is that tax cuts and benefit reductions can increase the volatility of households' disposable income and hence increase macroeconomic fluctuations. We estimate the size of Sweden's automatic stabilizers over the period 1998-2019 using standard methods. We find that the implementation of policies to make work pay have not impaired automatic stabilizers, due to the design of these reforms. The size of the automatic stabilizers decreased somewhat but mainly in the first half of the sample. Our baseline estimate of the size of the automatic stabilizers in Sweden is about 0.5 over the entire period. Roughly speaking this means that a 1 percentage point increase in the GDP gap automatically leads to a 0.5 percentage point increase in the fiscal balance as a share of GDP. We construct 68 percent confidence intervals based on the uncertainty stemming from the underlying regressions and the bound for the interval is +/-0.05 around the point estimate We conduct several robustness tests. The overall conclusion from these tests is that our baseline estimate is reasonably robust. Widening the definition of automatic stabilizers to include discretionary expenditures for active labour market programs, a so called semi-automatic fiscal stabilizer, has only a modest effect. Data suggest that a large share of the long run variation in such expenditures is not explained by variations in unemployment or in the number of persons enrolled in active labour market programs, casting some doubt on the extent to which they may be considered semi-automatic.

JEL: E62, H60, J30

Keywords: Automatic fiscal stabilizers, budget elasticity, robustness test, semi-automatic fiscal stabilizers, uncertainty

1 Introduction

In the EU, US and elsewhere, policies to make work pay have held a prominent position in the labour market policy debate in recent decades (see, for example, Blundell (2006)). Such policies aim to increase labour market attachment and thereby alleviate poverty, for example through lowering taxes on earned income and reducing benefits to the unemployed.

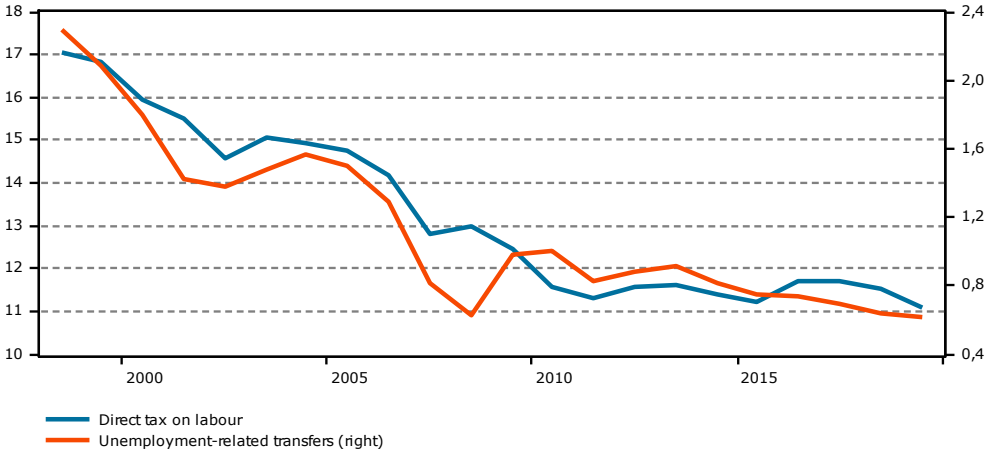
At the same time, macroeconomic stability continues to be an important goal for economy policy. Fiscal policy can reduce macroeconomic fluctuations through discretionary policy, but also through automatic (fiscal) stabilizers. Simply put, rules and regulations that determine public sector revenues and expenditures can automatically soften the impact of the business cycle on households and firms.[1] A potential drawback of policies to make work pay is that income taxes and benefits reduce the volatility of households' disposable income, and so tax cuts and benefit reductions risk increasing macroeconomic fluctuations. This points to a potential conflict between stabilization policy and policies to make work pay.

We use data from Sweden to shed more light on the trade-off between policies to make work pay and the size of automatic fiscal stabilizers. Sweden is an interesting example because it is a welfare state that has undertaken sizeable reforms to strengthen work incentives. As shown in figure 1, taxes on labour income were reduced by about 5 percent of GDP over the course of 20 years. About half of this is due to an earned income tax credit that was first introduced in 2007 and later expanded in several steps. At the same time, expenditure on unemployment-related benefits also decreased substantially over the period. Our key finding is that despite the scope of these reforms, automatic fiscal stabilizers in Sweden have not been impaired to any large extent. This reflects the design of these reforms.

[1] When economic activity declines, tax revenues decline while unemployment may rise causing an increase in rule-based unemployment-related expenditures. When economic activity increases, the reverse may occur. These changes in public revenues and expenditures are automatic to the extent that they are rule-based, and result in smaller variations in disposable income for households and firms and hence smaller variations in private sector aggregate demand. The government's budget balance, by contrast, will display larger variations as a result.

Figure 1 Tax on labour income and unemployment-related benefits

Percent of GDP



Source: Statistics Sweden

Automatic stabilizers are important because efficient stabilization policy requires stabilizing measures to be carried out without too much delay, or else economic conditions might change before they are in place, and targeting those areas of the economy where they can be expected to have a large effect. Moreover, if the measures are undertaken for the sole purpose of stabilizing the business cycle they should be temporary and reversed when economic conditions no longer call for them. Unlike discretionary fiscal policy, automatic stabilizers do not require active political decisions in order to operate and hence are a potentially important means of stabilizing economic activity.[2]

Moreover, having an updated view of the size of the automatic stabilizers is important in itself: it helps policy makers understand how the economy functions, and the need for discretionary stabilization policy, as well as gives a way to assess how the state of the economy affects the government's budget balance (and hence to make predictions about fiscal space). Automatic stabilizers are affected by discretionary decisions regarding income taxes and unemployment benefit levels.[3] Since the size of the automatic stabilizers changes due to political decisions it is important to assess, from time to time, their current size.

[2] Using discretionary fiscal policy to stabilize economic activity is a challenge. Political decisions may be prone to decision lags and there is a risk that short term political considerations result in the wrong measures being taken. In addition, there is a temptation to make temporary measures permanent. Following the great recession there has been a lively debate about the use of fiscal policy as a tool for stabilization policy but no new consensus has been established (see for example DeLong och Summers, 2012; Blinder, 2016; Furman, 2016).

[3] If the government increases (decreases) the benefit level in the unemployment insurance so that unemployed workers get more (less) compensation in case of unemployment it will result in more (less) income to the household sector during recessions when the unemployment is high. At the same time the government's budget balance decreases (increases).

We estimate the size of automatic fiscal stabilizers in Sweden in the period 1998-2019, using a common approach first proposed by Girouard and André (2005). This method decomposes the elasticity of the fiscal balance to the business cycle into two components: (a) a structural part reflecting tax and benefit rules, and (b) a cyclical part reflecting how tax bases and benefit-related aggregates respond to the state of economy.

A strength of this approach is that the first component can be assessed using rules and regulations that apply in a given year, while the second component can be estimated over a longer time horizon using time-series data. However, this approach has limitations as well. It does not explicitly model the behaviour of agents in the economy, and is hence subject to the Lucas critique. Moreover, it does not take into account what type of shock is affecting the economy. It is, simply put, an unconditional expectation of the fiscal balance given a certain change in GDP. But even this simple measure is informative, and is widely used as a rule of thumb in fiscal policy.

The same approach has previously been applied to Sweden in Flodén (2009). Flodén (2009) reports that the size of the automatic stabilizers decreased from close to 0.6 in 1998 to only slightly above 0.5 in 2009. Roughly speaking this would imply that a 1 percentage point change in the GDP gap would be expected to change the government fiscal balance (as a share of GDP) by 0.6 percentage points in 1998, and by 0.5 percentage points in 2009. Flodén also calculates a broader measure of automatic stabilizers that includes discretionary expenditures that are deemed to be "semi-automatic stabilizers", i.e. expenditures that are discretionary but can be expected to be closely correlated with automatic stabilizers, in particular expenditures on active labor market policies. Flodén finds that this broader measure decreased from just above 0.7 in 1998 to slightly more than 0.6 in 2009.[4]

We extend the analysis in several ways. First, we use a decade of additional data. Second, we conduct extensive robustness checks. Third, we shed more light on the so called semi-automatic stabilizers. In our view, the data suggest that these semi-automatic stabilizers are considerably smaller than the estimates put forward in Flodén (2009) and that there is some doubt as to whether they can really be considered semi-automatic.

[4] Flodén (2009) finds that the total value of the automatic stabilizers was 0.58 in 1998 and 0.53 in 2009, and that the total value inclcuding semi-automatic stabilizers was 0.71 in 1998 and 0.63 in 2009 (see table 3.10 in Flodén (2009)).

We find that automatic stabilizers in Sweden declined somewhat in the period 1998–2019 but mainly in the first half of this period. Direct taxes on labour income decreased considerably during these years, reducing the size of the automatic stabilizers. But these tax changes reduced the average tax rate more than the average marginal tax rate, resulting in an increase in the progressivity of taxation. This partly offsets the effect of the lower taxes on the automatic fiscal stabilizers. Expenditure on unemployment benefits also decreased during the first half of the period, contributing to lower automatic stabilizers. Overall, however, the reduction in the size of the automatic stabilizers is modest, considering the scope of the reforms carried out. In particular, it is noteworthy that the introduction and gradual scaling up of the earned income tax credit from 2007 onwards, does not appear to have impaired automatic stabilizers.

We test the robustness of our estimates in a number of different ways. When we estimate how tax and benefit-related aggregates respond to changes in the business cycle, we use data going back to 1982. But the Swedish economy has evolved during this time. Notably, the inflation target introduced in 1993, together with central bank independence in 1999, gradually anchored inflation expectations. Collective wage bargaining was also reformed, in particular through the Cooperation Agreement on Industrial Development and Wage Formation[5] that was introduced in 1997 and used as a framework ever since. These reforms changed wage formation in Sweden in a fundamental way.[6] Between 1998 and 2019, real wage growth in the business sector averaged 2.0 percent, while nominal wage growth averaged 3.2 percent. By contrast, the period 1981–1997 was characterized by higher nominal wage growth, on average 6.6 percent, while real wage growth only averaged 0.8 percent due to high inflation.[7] Empirical tests also indicate that a structural break occurred in the late 1990s. The size of the automatic stabilizers is not greatly affected by restricting the sample to exclude older data. Using a shorter sample from 1998–2019 generates estimates of the automatic stabilizers that are around 0.1 lower than in our baseline estimates. The overall conclusion, that the automatic stabilizers declined somewhat in the period 1998–2019 but mainly in the first half of this period, is unaffected.

In the baseline estimates we assume that that all workers, regardless of their position in the income distribution, are affected by the business cycle. But it is possible that the lower

[5] In Swedish: *Industriavtalet*.

[6] However, it is not clear from a theoretical stand point how these reforms affects the size of the autoamtic stabilizers.

[7] The data on wages in the business sector 1980-1992 is linked by NIER using previously published data from Statistics Sweden.

part of the income distribution is more affected.[8] Using only the lower part of the income distribution marginally decreases the estimated size of the automatic stabilizers compared to our baseline estimates at the beginning of the time period we study, but marginally increases the size from 2007 and onwards.

An assumption underlying the baseline estimates is that workers' intensive margin is affected by the business cycle, while the extensive margin is unaffected.[9] We evaluate how the results change when we allow for changes in the extensive margin. We take into account the fact that the effective tax rate on wages can differ from the tax rate on unemployment benefits. Accounting for the extensive margin marginally decreases the size of the automatic stabilizers from 2007 and onwards.

Our method uses macroeconomic aggregates as proxies for the tax bases for direct labour taxes and the corporate income tax, respectively. We also evaluate the effects on the automatic stabilizers using definitions of the tax bases which are closer to the definitions used in the national accounts. At the same time, we expand the scope of which transfers to households that are assumed to be affected by the business cycle. Due to lack of data we can only perform this analysis using data from 1998-2019. We find that these modifications slightly increase the size of the automatic stabilizers compared to the calculations where we estimated the underlying elasticities on data from 1998-2019, but they are still lower than the baseline calculations. However, the modest decline in the size of the automatic stabilizers that we find in our baseline estimate is unaffected.

Unemployment benefits is the only expenditure that is assumed to be automatically affected by the business cycle in the baseline estimates. But there are discretionary expenditures closely linked to unemployment, in particular expenditures on active labour market programs, that can be expected to be closely linked to the automatic stabilizers and hence function as a form of semi-automatic stabilizer. We find, however, that a significant share of the variation in expenditures on active labour market programs is not easily explained by variations in unemployment or in the number of persons enrolled in such programs. This casts some doubt on the relevance of semi-automatic stabilizers. In our view, the data suggest that using a wider definition of automatic stabilizers that include semi-auto-

[8] One way to think about this is that wages in well-paid professions such as doctors are less affected by the business cycle than the wages of lower paid individuals such as construction workers.

[9] The intensive margin refers to the tendency of those already in the labour force to change the hours of labour supplied as net wages change, while the extensive margin refers to the tendency of individuals to join or leave the labour force as net wages change.

matic stabilizers may increase the automatic stabilizers only very marginally, and the contribution is an order of magnitude smaller than the contribution estimated on a shorter sample in Flodén (2009).

Our calculations use point estimates from regressions. The uncertainty around these estimates translate into uncertainty around our overall calculations. We evaluate how the uncertainty that stems from these regressions affect the size of the automatic stabilizers, calculating a 68 percent confidence interval. We find that the uncertainty is not negligible.

The rest of this paper is organized as follows: Section 2 outlines the method and the data. In Section 3, we present our baseline results followed by robustness tests in section 4. The robustness tests show how our assessment of the automatic stabilizers is affected by (i) shortening the sample to only include data from 1998 onwards, (ii) different assumptions regarding the income distribution, (iii) different assumptions about how the intensive/extensive margin changes over the business cycle, (iv) a different definition of wage sum and profit share as well as unemployment-related transfers, (v) the inclusion of expenditures that may (rightly or wrongly) be deemed to function as semi-automatic stabilizers, and (vi) the uncertainty that stems from the regressions. A general discussion of the results in section 5 concludes.

2 Methods and data

The method that we use was first proposed by Girouard and André (2005), and applied to Sweden by Flodén (2009). This method uses the budget elasticity, which describes the response of the fiscal balance to fluctuations in GDP around its trend[10], as a measure of the size of the automatic fiscal stabilizers. The budget elasticity is calculated using a disaggregated approach[11], estimating separate elasticities for four categories of tax revenues as well as for total expenditures. These elasticities are then added using GDP shares as weights, according to the equation[12]

$$\alpha = \sum_i \varepsilon_i \frac{T_i}{Y} - \gamma \frac{G}{Y} \qquad (1)$$

where α is the budget elasticity with respect to changes in the GDP gap, ε_i is the elasticity of revenue from tax i with respect to the GDP gap, $\frac{T_i}{Y}$ is tax i:s share of GDP, γ is the elasticity of primary expenditure with respect to the GDP gap and $\frac{G}{Y}$ is primary expenditures (expenditures net of interest payments) as a share of GDP. How to arrive at equation (1) is shown in the appendix.

The elasticities ε_i och γ show how public revenues and expenditures respond to changes in GDP, and can be separated into two constituent parts. On the revenue side, the first part is how tax revenues change in response to changes in the tax base, and the second part is how tax bases change in response to business cycle developments. Let Y^* be potential GDP, and let τ_i, y and y^* denote the logarithm of T_i, Y and Y^*respectively. Let β_i be the logarithm of the tax base for tax i. The following applies[13]

[10] The budget elasticity can be used, together with the GDP gap and public sector's budget balance, to calculate the cyclically adjusted budget balance which shows the underlying fiscal position when cyclical movements are removed.

[11] A disaggregated approach is used by Van den Noord (2000); Girouard and André (2005); Flodén (2009); Price et al. (2015). The benefit of using a disaggregated approach is that longer time-series can be used to estimate the relationship between the business cycle and the tax bases while elasticities that depend on political decisions, e.g. the elasticity between tax revenues and the tax based, can be modeled explicitly. Another method is micro simulations, as done by Auerbach and Feenberg (2000); Auerbach (2009), or macro simulations, as in NIER (2015); McKay and Reis (2016). The advantage of macro simulations is that they can capture how the size of the automatic stabilizers depends on the type of shocks that hit the economy.

[12] All variables in the following equations are for the same year. Hence, we exclude time indices.

[13] It follows from the chain rule of calculus, provided that the tax base is a continuous and differentiable function of the GDP gap.

$$\varepsilon_i = \frac{\partial \tau_i}{\partial (y - y^*)} = \frac{\partial \tau_i}{\partial \beta_i} \frac{\partial \beta_i}{\partial (y - y^*)} \equiv \epsilon_{\tau_i} \epsilon_{\beta_i} \quad (2)$$

where the first term, ϵ_{τ_i}, is the elasticity of tax revenue with respect to the tax base, and the second term, ϵ_{β_i}, is the elasticity of the tax base with respect to the business cycle.

On the expenditure side, a similar calculation is performed by looking at how expenditures change in response to changes in unemployment, and how unemployment changes in response to changes in GDP. Denote the elasticity of expenditure with respect to changes in the GDP gap by γ_u. Let G be primary expenditure, and let g denote the log value of G, we can write

$$\gamma = \frac{\partial g}{\partial (y - y^*)} = \frac{\partial g}{\partial (u - u^*)} \frac{\partial (u - u^*)}{\partial (y - y^*)} \equiv \gamma_g \gamma_u \quad (3)$$

where u and u^* are the logged values of unemployment and equilibrium unemployment, respectively.

In sum, for the different tax categories and for primary expenditures, there are three factors that determine their contribution to the overall budget elasticity. First, how tax bases and unemployment respond to changes in the business cycle. Second, how tax revenue and primary expenditures respond to changes in the tax bases and unemployment. Third, the relative size of the respective tax categories and primary expenditure in relation to GDP.

We use yearly data from the national accounts, published by Statistics Sweden (SCB) in February 2020. For macroeconomic variables, such as GDP, firms' share of the total value-added in the economy, and the wage sum we use data from 1980 to 2019. For public expenditures and tax revenues, we use data from 1998 to 2019. When calculating the elasticity of direct taxes on labour with respect to its tax base, we approximate the distribution of wage income in 2016, based on microdata from Statistics Sweden.

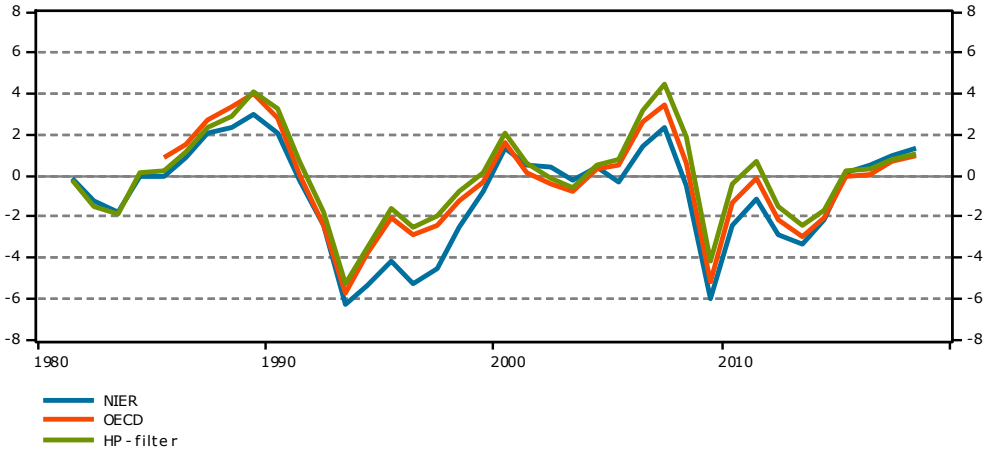
Some variables used in the analysis are not observable and hence not reported in the national accounts. We use the GDP gap and the equilibrium unemployment as calculated by NIER and published in the NIER forecast in April 2020 (NIER, 2020).

Throughout the calculations, we use the GDP gap as a measure of the business cycle. The GDP gap, $\frac{Y - Y^*}{Y^*}$, shows the deviation of actual GDP from its long run equilibrium trend (i.e. the level of production that is achieved given full resource utilization of the

available factors of production labour and capital at a given time). Potential GDP can be assessed in different ways. We use NIER:s estimate of the GDP gap.[14] NIER uses a standard approach in which potential GDP is constructed from the bottom up using estimates of its constituent parts, such as equilibrium unemployment, potential productivity, and potential hours worked and figure 2 shows that there is a close similarity between the GDP gap as estimated by NIER and estimated by the OECD (the correlation is 0.95). An alternative approach is to apply a statistical filter such as the HP-filter to actual GDP and letting the filtered series (the trend) represent potential GDP. An HP-filtered series also shows a similar pattern, broadly speaking. The HP-filtered GDP gap has a correlation of 0.93 with the gap estimated by NIER and 0.98 with the gap estimated by OECD. With all three measures, the recession that followed the financial crisis in 2008 was approximately as deep as the recession that followed the crisis in the early 1990s, but the recession after the financial crisis was shorter in duration.

Figure 2 GDP gap in Sweden 1980–2019

Percent of potential GDP



Note. The GDP gap from OECD is from OECD (2019). The HP-filtered GDP gap shows the gap where potential GDP is determined as the HP-filtered trend, with lambda 100, of real GDP.

Sources: OECD, NIER and own calculations.

3 Main results

3.1 Estimating revenue elasticities

As outlined above, the budget elasticity is constructed using separate estimates for tax revenues and expenditures. The revenue side is in itself constructed from separate estimates for four tax categories: direct taxes on labour[15], payroll tax, corporate income tax and indirect taxes[16].

The calculations proceed in two steps: first, we estimate the elasticity of the tax base with respect to the business cycle using time series data, and second, we calculate, year by year, the elasticity of tax revenues to changes in the tax base, using the tax rules for each specific year. Taking into account how the tax code has changed over time is particularly important for labour taxes that tend to be progressive, because the progressivity of taxation, and not just the level, affects the size of automatic stabilizers.

THE LABOUR COST SHARE

The labour cost share of GDP plays an important role in the calculations, since it serves as a proxy for the tax bases for direct taxes on labour as well as payroll taxes. We define the labour cost broadly as all output that is not allocated to firms as gross profits. In a parsimonious model of the economy, production is carried out with the two factors labour and capital. The compensation of labour is wages and payroll tax and the compensation of capital is profit in a broad sense. GDP can then be divided into a labour cost share and a profit share. We define profits as the product of (i) gross surplus as a share of firms' value-added and (ii) firms' share of the total value-added in the economy. This definition, which is broader than in the national accounts, is used by Girouard and André (2005) as well as Flodén (2009). For an alternative approach, see Price et al. (2015).

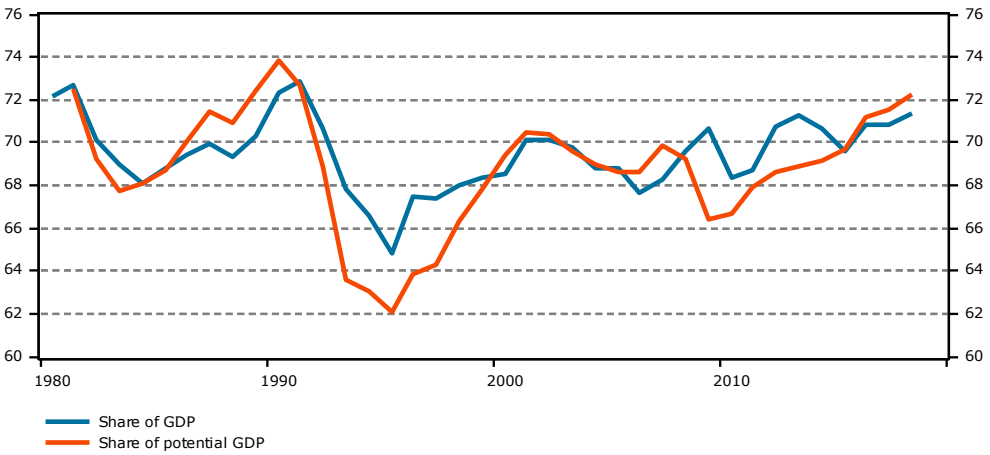
[15] The tax that households pay on their labour income, net of tax reductions such as the earned income tax credit.

[16] This category mainly includes VAT but also tax on the household's capital income.

Defined this way, the labour cost share has varied around approximately 70 percent of GDP, without a trend (see figure 3). We use the estimation from the cross-country analysis in Girouard and André (2005) and assume that the labour cost share is 72 percent of GDP in equilibrium, and hence the profit share is 28 percent of GDP.[17]

Figure 3 Labour cost share in Sweden 1980–2019

Percent



Note. The labour cost share is calculated as the share of GDP that is not allocated to firms as gross profits.

Sources: Statistics Sweden, NIER and own calculations.

The elasticity of the labour cost share of potential GDP with respect to the GDP gap[18], ϵ_{β_w}, is estimated according to

$$\Delta(w_t - y_t^*) = a + \epsilon_{\beta_w}\Delta(y_t - y_t^*) \qquad (4)$$

where w is the log value of the labour cost, and, as before, y and y^* are the log values of actual and potential GDP, respectively.[19] The relationship stated in equation (4) is estimated using OLS. The time series used to estimate equation (4) are shown in the appendix (see figure 11).

The elasticity of the labour cost share to the GDP gap is 0.82, when estimated over the entire period 1982–2019. As a sensitivity analysis we also estimate the elasticity using subsets of the time series, and get estimates ranging from 0.49 to 1.23 (see table 12 in

[17] As a robustness test we estimate the size of the automatic stabilizers when we use the wage sum from the national accounts as definiton of labour costs, see section 4.4.

[18] The definition of the GDP gap in the regressions is $\frac{Y}{Y^*}$.

[19] The left-hand side of the equation shows the logarithm of the labour cost as share of potential GDP and the right-hand side shows the GDP gap.

the appendix).[20] Narrowing the estimation period to only include data from 1998 and onwards, a period when Sweden has had a new wage bargaining norm, gives an elasticity of 0.55.[21]

An important reason why the estimates differ is that the labour cost share reacted more than GDP during the protracted recession in the early 1990s. The recession that followed in the wake of the financial crisis in 2008 was shorter and the labour cost share did not react as much. This difference is explained by the fact that the two crises were of different kinds. The crisis in the 1990s was domestic and due to low competitiveness of the business sector and unsustainable public finances whereas the financial crisis of 2008 was foreign, so Swedish firms were probably more prone to labour hoarding (Hassler, 2010).

Whether it is more appropriate to use a longer time series, with a greater risk of violating the assumption of stationarity, or a shorter time series that contains less information, is an open question. We opt for the former, and take an elasticity of 0.82 as our baseline. This estimate draws on data from the whole period 1982–2019 and is in line with earlier estimates by the OECD.[22] But we note that the considerable uncertainty surrounding the estimation of this elasticity is a source of uncertainty regarding our calculations of the overall budget elasticity. We return to this issue later, when we test for structural breaks in the time series, and when we analyze how the uncertainty that stems from the regressions affect the results.

DIRECT TAXES ON LABOUR

The elasticity of direct taxes on labour with respect to the labour cost share depend on both the level and the progressivity of income taxes. Sweden has relatively high taxes on labour income but the level has been reduced during the last 20 years, mainly through the introduction of a tax reduction for the general pension fee[23] and the introduction of

[20] The regressions are estimated with OLS and Newey-West standard errors. The coefficients are significant at the one percent level. The Durbin-Watson test indicates that the serial correlation in the error term is small. The inclusion of a trend in the regression does not change the result.

[21] This is analyzed further in the section with robustness tests.

[22] See Girouard and André (2005).

[23] In Swedish: *Skattereduktion för allmän pensionsavgift*. The national public pension in Sweden is financed by both firms and workers. Workers have to contribute to the public pension and before 2000 the contribution was tax deductible. Year 2000 the system changed so that 25 percent of the contribution allows for a tax reduction whereas the remaining share was tax deductible. The share that gave a tax reduction gradually increased and from 2006 the entire contribution allows for a tax reduction.

an earned income tax credit[24]. In total these two reforms, which were similar in magnitude and in both cases phased in gradually, reduced taxation of labour income by about 5 percent of GDP. In both cases, but in particular in the case of the earned income tax credit, the reforms targeted low and medium wage earners. Hence, the effect (on the elasticity) of lowering the level of taxation was offset by an increase in progressivity, in the sense that marginal tax rates were reduced at lower income levels but not at higher income levels.

If an individual worker has wage W with the marginal tax rate $m(W)$ and average tax rate $a(\mathrm{W})$ the elasticity between the tax and the wage can be calculated as the ratio between the marginal tax and the average tax, $m(W)/a(\mathrm{W})$. This relationship is used when calculating the elasticity between direct taxes on labour and the labour cost share, $\epsilon_{\tau w}$.

The calculations are performed year by year, in two steps. First, the marginal and average tax rate are evaluated at different income levels. Next, the elasticity is calculated as the ratio of the weighted average of the marginal and average tax rates, according to

$$\epsilon_{\tau_w} = \frac{\sum_j m(W_j) f(W_j)}{\sum_j a(W_j) f(W_j)} \tag{5}$$

where W_j is the wage of individual j and $f(W_j)$ is the wage weighted share of the population with wage W.

We use the specific tax rules for each year 1998-2019 to calculate the income tax as a function of year and wage.[25] At each wage level, we find the marginal tax by calculating how much the tax increases when the labour income is increased a standardized amount that is indexed to aggregate wage growth over time. [26]

The distribution of wage income is based on micro data from Statistics Sweden for 2016. The distribution has its starting point around the median wage $\overline{W}$ and shows how

[24] In Swedish: *Jobbskatteavdraget*.

[25] The Matlab code can be found at http://www.konj.se/publikationer/working-paper. Please note that in the Swedish tax code, income is either taxed as labour income or capital income. Wages here refers to all income that is taxed as labour income, regardless of its source, including taxable social benefits.

[26] Specifically, we increase the annual wage by one half of the price base amount (in Swedish: *prisbasbelopp*). The marginal increase in our calculations is roughly one tenth of the medium wage. Our result does not hinge on making that specific increase. Smaller or larger increases yield the same result.

large share of the population that has income $\{0.01\bar{W}, 0.02\bar{W}, \ldots, 8.00\bar{W}\}$. The income distribution is assumed to have the same shape for all the years, but scaled with the median wage of each year.[27]

Our calculations make an implicit assumption that when labour costs increase all wages increase proportionally. However, there are reasons to believe that one of the factors that affect the labour costs is when workers move in and out of employment. Low-paid workers may be over-represented in this category, and since they face lower marginal and average tax rates this might affect the elasticity. Also, the introduction of the earned income tax credit has changed the tax for an employed worker compared to an unemployed worker with unemployment insurance, which also affects the elasticities. These questions are further investigated in the section with robustness tests.

The elasticity of direct taxes on labour with respect to the labour cost share is calculated as the ratio of the (average) marginal tax rate and the average tax rate. The calculations show that the marginal tax rate was reduced, on average, by 8 percentage points between 1998 and 2014, from 45.5 percent to 37.4 (see column 1 in table 1). After 2014 the averaged marginal tax rate increased somewhat, to 38.7 percent 2019. The average tax rate faced by an individual has, on average across the wage distribution, been reduced from 36.0 percent in 1998 to 25.8 percent in 2019 (see column 2 in table 1). We find that the average tax rate was, on average across the distribution, at its lowest level in 2014, 25.1 percent. Importantly, the reduction in the average tax rate exceeds the reduction in the marginal tax rate. This implies that the elasticity between direct taxes on labour and the labour cost share has increased between 1998 and 2019.

The elasticity of direct taxes on labour with respect to the labour cost share was at its lowest in 1999 and has increased by more than 0.2 since then, from 1.24 to 1.50 in 2019 (see column 3 in table 1). The biggest increase between adjacent years was between 2006 and 2007 when the elasticity increased by 0.10 . The elasticity has been constant during the last decade.

[27] The income distribution for 2016 is used for all years, but it is adjusted according to the evolution of the median income. This means that the same share of the population is assumed to have, for example half the median wage, each year. To ensure that our results are not affected by this assumption we have also calculated the elasticity using the income distributions from 2004 and 2010 without any significant effects on the results, see NIER (2018). The median wage for 2019 is approximated by increasing the median wage of 2018 with the change in the average hourly wage of the Swedish economy.

Table 1 The elasticity of direct taxes on labour with respect to the labour cost share ($\epsilon_{\tau w}$)

Percent and elasticity respectively

	Average marginal tax rate (percent)	Average tax rate (percent)	Elasticity
1998	45.5	36.0	1.26
1999	44.1	35.7	1.24
2000	43.3	34.7	1.25
2001	42.2	33.6	1.26
2002	41.0	32.2	1.27
2003	42.1	32.4	1.30
2004	42.4	32.7	1.30
2005	42.5	32.1	1.32
2006	42.5	31.6	1.34
2007	41.0	28.4	1.44
2008	40.7	27.6	1.47
2009	38.6	26.2	1.47
2010	38.1	25.4	1.50
2011	38.1	25.5	1.49
2012	37.9	25.5	1.49
2013	37.9	25.7	1.48
2014	37.4	25.1	1.49
2015	37.8	25.4	1.49
2016	39.2	26.1	1.50
2017	39.5	26.3	1.50
2018	39.3	26.3	1.50
2019	38.3	25.6	1.50

Source: Own calculations.

The elasticity of direct taxes on labour with respect to the labour cost share, as shown in column 3 in table 1, is multiplied with the elasticity of the labour cost share with respect to the business cycle, previously estimated to 0.82, to obtain the elasticity of direct taxes on labour with respect to the business cycle.

PAYROLL TAXES

The elasticity of payroll taxes with respect to the GDP gap is the product of (i) the elasticity of the labour cost share and the business cycle (estimated to be 0.82; see above), and (ii) the elasticity of payroll taxes with respect to the payroll (here proxied by the labour cost share), which is 1.0 since payroll taxes are not capped in Sweden. Multiplying (i) and (ii) gives an elasticity of payroll taxes with respect to the business cycle of 0.82.

CORPORATE INCOME TAX

The elasticity of the corporate income tax with respect to the GDP gap is the product of (i) the elasticity of corporate profits and the business cycle, ϵ_{β_c}, and (ii) the elasticity of the corporate income tax with respect to corporate profits.

For the purpose of calculating elasticities, corporate profits are proxied by the share of GDP that is not the labour cost share. While in theory this is the part of value-added that accrues to firms, it is quite different from taxable profits that allow for deductions for depreciation, interest and other items. Taxable profits amount to about 10 percent of GDP, whereas the profit share, defined as 1-labour cost share, is about 25–30 percent. However, we use this approximation because we are estimating elasticities and not levels. This approach, which is in line with previous research, implies that all additional value-added that accrues to firms in a boom is taxable. (In the section with robustness tests we relax this assumption.) This assumption allow us to calculate the elasticity of profits with respect to the business cycle using the profit share and the elasticity of the labour cost share and the GDP gap, according to the following equation:

$$\epsilon_{\beta_c} = \frac{1-(1-\theta)\epsilon_{\beta_w}}{\theta} \tag{6}$$

where θ is the profit share in the economy.

As mentioned above, we assume the profit share to be 0.28 in equilibrium, and we have estimated the elasticity of the labour cost share to the GDP gap, ϵ_{β_w}, to be 0.82. Plugging these values into equation (6) gives an elasticity of profits to the GDP gap, ϵ_{β_c}, of 1.46. The Swedish corporate income tax is proportional to profits, so as an approximation the corporate income tax revenue responds one-to-one to changes in profits (but since losses can be offset against future profits this is only an approximation, albeit a reasonable one). Since the corporate income tax is assumed to be proportional to profits, the elasticity of the corporate income tax with respect to the business cycle is also 1.46.

INDIRECT TAXES

Indirect taxes here refer to consumption taxes in the form of value added taxes and excise taxes, as well as taxes on household capital income. It is hard to assess how these tax bases correlate with the GDP gap. Following Girouard and André (2005), we assume an elasticity of 1. Since these taxes are largely proportional, the elasticity of tax

revenue to the tax bases is also set to 1. Hence the elasticity between tax revenue from these indirect taxes and the GDP gap, which is the product of the two elasticities, is 1.0.

SUMMARY OF REVENUE ELASTICITIES

The above calculations are summarized in table 2. Column (iii) shows how the elasticity of direct labour taxes to the GDP gap has increased over time, driven by an increase in the elasticity of direct taxes on labour with respect to the labour cost, as shown in column (ii).[28] The other three revenue elasticities (payroll taxes, corporate income tax and indirect taxes) are constant.

[28] Remember that the elasticity of labour cost with regard to the GDP gap is assumed to be constant at 0.82.

Table 2 Tax elasticities with respect to the GDP gap

Elasticity

	ϵ_{β_w}	ϵ_{τ_w}	Direct taxes on labour	Payroll tax	Corporate income tax	Indirect taxes
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
1998	0.82	1.26	1.04	0.82	1.46	1.00
1999	0.82	1.24	1.02	0.82	1.46	1.00
2000	0.82	1.25	1.02	0.82	1.46	1.00
2001	0.82	1.26	1.03	0.82	1.46	1.00
2002	0.82	1.27	1.04	0.82	1.46	1.00
2003	0.82	1.30	1.07	0.82	1.46	1.00
2004	0.82	1.30	1.07	0.82	1.46	1.00
2005	0.82	1.32	1.09	0.82	1.46	1.00
2006	0.82	1.34	1.10	0.82	1.46	1.00
2007	0.82	1.44	1.19	0.82	1.46	1.00
2008	0.82	1.47	1.21	0.82	1.46	1.00
2009	0.82	1.47	1.21	0.82	1.46	1.00
2010	0.82	1.50	1.23	0.82	1.46	1.00
2011	0.82	1.49	1.23	0.82	1.46	1.00
2012	0.82	1.49	1.22	0.82	1.46	1.00
2013	0.82	1.48	1.21	0.82	1.46	1.00
2014	0.82	1.49	1.23	0.82	1.46	1.00
2015	0.82	1.49	1.22	0.82	1.46	1.00
2016	0.82	1.50	1.23	0.82	1.46	1.00
2017	0.82	1.50	1.24	0.82	1.46	1.00
2018	0.82	1.50	1.23	0.82	1.46	1.00
2019	0.82	1.50	1.23	0.82	1.46	1.00

Note. Columns (i) and (ii) show the elasticity of the labour cost share with respect to the GDP gap and the tax income with respect to the labour cost. The product of the two colums give the elasticity of direct taxes on labour with respect to the GDP gap, and is displayed in column (iii). Column (iv) to (vi) shows the elasticities for each tex with respect to the GDP gap.

Source: Own calculations.

3.2 Estimating the expenditure elasticity

ELASTICITY OF UNEMPLOYMENT WITH RESPECT TO THE GDP GAP

The elasticity of the unemployment gap[29] with respect to the GDP gap is estimated using the following regression:

$$\Delta(u_t - u_t^*) = a + \gamma_u \Delta(y_t - y_t^*) \qquad (7)$$

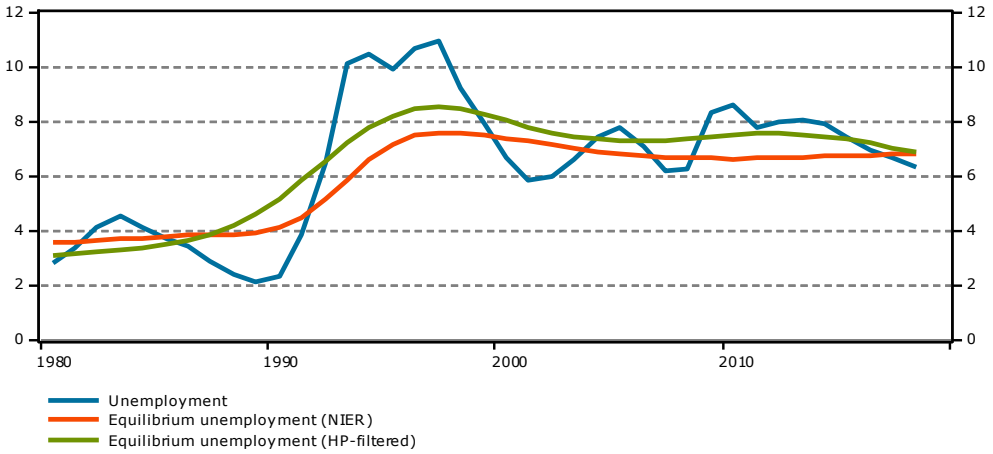
where, as before, u and u^* are the log values of unemployment and equilibrium unemployment (in the following, we refer to the difference between the two as the *unemployment gap*). Both sides of equation (7) are illustrated in the appendix (see figure 12).

Equilibrium unemployment is not directly observable, and estimates thereof are sensitive to the assumptions made. In addition, there are different ways of defining equilibrium unemployment. For our calculations, we use estimates published by NIER in April 2020 (NIER, 2020), that define equilibrium unemployment as the unemployment rate that would prevail if the GDP gap is zero and the economy progresses along its balanced growth path. Figure 4 shows an estimate of this cyclically adjusted unemployment rate.

[29] The definition of the unemployment gap in the regressions is $\frac{U}{U^*}$.

Figure 4 Unemployment in Sweden 1980–2019

Percent



Note. Refers to individuals 15–74 years old. The HP-filtrered equilibrium unemployment shows the trend that results when the unemployment rate is HP-filtered with lambda 100.

Sources: Statistics Sweden, NIER and own calculations.

When equation (7) is estimated using data from the whole period 1982–2019 the elasticity is –6.06. The negative sign is as expected: in a boom, GDP is above trend and so the GDP gap is positive, while unemployment is below its equilibrium level and hence the unemployment gap is negative, and in a recession we would expect the reverse. The estimate implies that when the equilibrium unemployment level is, for example, 7 percent, a 1 percentage point increase in the GDP gap lowers the unemployment rate by 0.4 percentage points.

The estimated elasticity is sensitive to the choice of sample period. As a sensitivity analysis we also estimate the elasticity using shorter (more recent) subsamples and get estimates ranging from –9.60 to –3.78 (see appendix, table 13). The latter, smallest value is obtained by estimating on data from 1998 and onwards, corresponding to the period since the industrial agreement changed Swedish wage bargaining.

We chose to use –6.06 as our baseline estimate. This is the estimate obtained using the full sample 1982–2019. If using the full sample implies overestimating the responsiveness of unemployment to the business cycle, then our estimate of the overall budget elasticity will be too high. We discuss this further later on.

PRIMARY EXPENDITURE

We divide primary expenditure, G, into two parts

$$G = \hat{G} + \sigma \qquad (8)$$

where $\hat{G}$ is all primary expenditure except unemployment-related transfers and σ is unemployment-related transfers (unemployment insurance and compensation for participants included in labour market programs). We assume that unemployment-related transfers constitute the only expenditure that varies with the business cycle. We further assume that unemployment-related transfers are proportional to unemployment. Letting σ^* denote the level of unemployment-related transfers when unemployment is at its equilibrium level, the relationship between expenditures and unemployment is

$$\sigma = \frac{U}{U^*}\sigma^* \tag{9}$$

Unemployment-related transfers are taxable in Sweden. The variable of interest for the automatic fiscal stabilizers is expenditures net of tax, denoted $(1-\tau_{\bar{w}})\sigma$. Each years' average tax rate for the median income is used when computing the net expenditure.[30] From this it follows that the elasticity of net primary expenditure with regard to the unemployment gap, γ_g, can be written as

$$\gamma_g = \frac{\partial g}{\partial(u-u^*)} = (1-\tau_{\bar{w}})\frac{\sigma^*}{G^*} \tag{10}$$

where G^* is the underlying, structural, primary expenditures which are adjusted for the business cycle, and it will be approximated as G. This gives

$$\gamma_g = (1-\tau_{\bar{w}})\frac{\sigma}{G}\frac{U^*}{U} \tag{11}$$

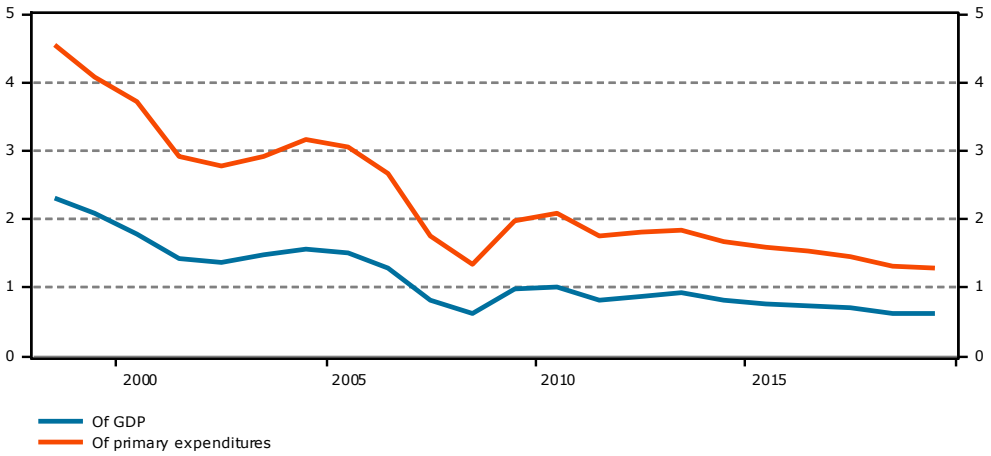
Expenditure on unemployment-related transfers has varied considerably over time, and has declined both as a share of GDP and as a share of primary expenditures (see figure 5). Three factors drove this downward trend in the 1998-2019 period: (i) unemployment declined, (ii) unemployment benefits did not increase at the same rate as nominal GDP, and (iii) a declining fraction of the workforce has been eligible for unemployment benefits.[31]

[30] The median income is slightly higher than the maximum income from unemployment insurance. Since most people are unemployed for only a part of the year the median income is a good approximation in this exercise.

[31] OECD reports in their tax-benefit data portal that the Swedish net replacement rates in unemployment has fallen from 82 percent in 2001 to 70 percent in 2019 for a worker that is unemployed for two months and has a previous wage that is 67 percent of the average wage. According to the Swedish Public Employment Service the share of the unemployed who received unemployment benefits decreased from 69 percent in 1999 to 45 percent in 2019.

Figure 5 Expenditures on unemployment-related transfers 1998–2019

Percent



Note. The expenditures in the figure are gross expenditures, i.e. before taxes.

Source: Statistics Sweden.

The data used to calculate the elasticity of expenditures with respect to the unemployment gap is reported in column (ii) to (vii) in table 3 and the elasticity is reported in column (viii).

As shown in column (viii) in table 3 the elasticity of primary expenditure with respect to the unemployment gap has decreased over time. The driver is the decrease in unemployment-related transfers, from about 4.5 percent of primary expenditures at the outset of the period to about 1.5 percent at the end. There is a slight offsetting effect from lower taxes on unemployment-related transfers, but this effect is small.

THE EXPENDITURE ELASTICITY

To get the elasticity between primary expenditures and the GDP gap we multiply the elasticity of the unemployment gap and the GDP gap, (estimated to be –6.06, see above and column (i) in table 3) with the elasticity of primary expenditure with respect to the unemployment gap (column (viii) in table 3). The results are reported in the final column of table 3. As shown, the elasticity of expenditure to the GDP gap has fallen by more than half over the period 1998-2019, driven by a reduction in unemployment-related transfers.

Table 3 Elasticity of expenditures to the GDP gap

Elasticity and percent respectively

	γ_u	$\tau_{\bar{w}}$	$\frac{\sigma}{G}$	$(1-\tau_{\bar{w}})\frac{\sigma}{G}$	U	U^*	$\frac{U^*}{U}$	γ_g	γ
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
1998	−6.06	32.7	4.5	3.1	9.2	7.5	0.8	2.50	−0.15
1999	−6.06	32.8	4.1	2.7	7.9	7.5	0.9	2.59	−0.16
2000	−6.06	31.9	3.7	2.5	6.6	7.4	1.1	2.80	−0.17
2001	−6.06	30.8	2.9	2.0	5.8	7.2	1.2	2.50	−0.15
2002	−6.06	29.5	2.8	2.0	6.0	7.1	1.2	2.34	−0.14
2003	−6.06	29.4	2.9	2.1	6.6	7.0	1.1	2.19	−0.13
2004	−6.06	29.7	3.2	2.2	7.4	6.9	0.9	2.07	−0.13
2005	−6.06	29.0	3.1	2.2	7.8	6.8	0.9	1.89	−0.11
2006	−6.06	28.3	2.7	1.9	7.1	6.7	0.9	1.82	−0.11
2007	−6.06	24.7	1.8	1.3	6.1	6.7	1.1	1.44	−0.09
2008	−6.06	23.7	1.3	1.0	6.2	6.6	1.1	1.09	−0.07
2009	−6.06	22.6	2.0	1.5	8.3	6.6	0.8	1.22	−0.07
2010	−6.06	21.7	2.1	1.6	8.6	6.6	0.8	1.26	−0.08
2011	−6.06	21.8	1.8	1.4	7.8	6.6	0.9	1.17	−0.07
2012	−6.06	21.8	1.8	1.4	8.0	6.7	0.8	1.18	−0.07
2013	−6.06	22.0	1.8	1.4	8.0	6.7	0.8	1.20	−0.07
2014	−6.06	21.4	1.7	1.3	7.9	6.7	0.8	1.10	−0.07
2015	−6.06	21.7	1.6	1.2	7.4	6.7	0.9	1.12	−0.07
2016	−6.06	22.0	1.5	1.2	6.9	6.7	1.0	1.16	−0.07
2017	−6.06	22.2	1.5	1.1	6.7	6.8	1.0	1.16	−0.07
2018	−6.06	22.3	1.3	1.0	6.3	6.8	1.1	1.10	−0.07
2019	−6.06	21.7	1.3	1.0	6.8	6.8	1.0	1.01	−0.06

Note. The elasticity of the unemployment gap with respect to the GDP gap is reported in column (i). Column (ii) shows the average tax rate at the median income. Column (iii) shows the unemployment-related transfers as share of primary expenditures. Column (iv) shows the unemployment-related transfers net of taxes as share of primary expenditures. Column (v) shows unemployment and column (vi) equilibrium unemployment. Column (vii) shows the inverted unemployment gap. Column (viii) shows the elasticity of primary expenditures net of taxes and the unemployment gap, which is obtained by multiplying column (iv) and (vii). The expenditure elasticity with respect to the GDP gap is reported in column (ix) and obtained by multiplying column (i) and (viii). Note that the expenditure elasticity is divided by 100 to compensate for the fact that that column (iii) and (iv) are expressed in percent and not as shares.

Sources: Statistics Sweden, NIER and own calculations.

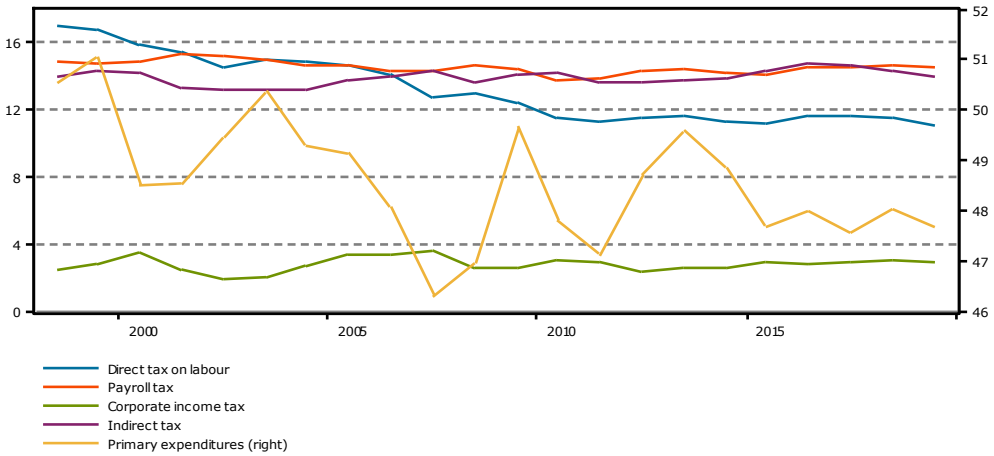
3.3 Combining the estimates

To get an estimate of the overall budget elasticity – and hence of the automatic stabilizers – we aggregate the estimated elasticities reported above, using GDP shares as weights. Figure 6 shows that direct taxes on labour have decreased as a share of GDP between 1998 and 2010 and have remained flat since 2010. The lower share is mainly a consequence of the tax credit for the employee pension contribution phased in from

1998, and the introduction of the earned income tax credit from 2007 and thereafter. Other taxes have remained relatively unchanged as a share of GDP. Primary expenditures have varied more over time with, perhaps, a modest downward trend.

Figure 6 GDP shares of taxes and primary expenditures 1998–2019

Percent of GDP



Sources: Statistics Sweden and own calculations.

Payroll taxes, corporate income tax and indirect taxes have been relatively stable as a share of GDP. Since by assumption their elasticities with respect to the GDP gap have not changed, the method we use implies that their contributions to the automatic stabilizers are about the same throughout the period.

Meanwhile, the contributions to automatic stabilizers from direct taxes on labour and primary expenditure have changed, as apparent from the first three columns in table 4. The elasticity of direct taxes on labour with respect to the GDP gap has increased during the time period studied, in particular during the first half of the period. Meanwhile direct taxes on labour as a share of GDP has decreased. The latter effect dominates, leading to an overall reduction in the contribution of direct taxes on labour to automatic stabilizers. This reduction occurred prior to 2010 and since then there has not been any significant change, even though a slight shift downwards can be observed.

The contribution from primary expenditure to automatic stabilizers has decreased, mainly due to a decrease in the elasticity during the first half of the time period studied, but also because primary expenditure as a share of GDP has shown a decreasing trend during the whole period (see the three rightmost columns in table 5).

Table 4 Weighted elasticities and contributions to automatic stabilizers

Elasticity and share respectively

	Direct taxes on labour			Primary expenditures		
	Elasticity	GDP share	Contribution	Elasticity	GDP share	Contribution
1998	1.04	0.17	0.18	−0.15	0.51	−0.08
1999	1.02	0.17	0.17	−0.16	0.51	−0.08
2000	1.02	0.16	0.16	−0.17	0.49	−0.08
2001	1.03	0.16	0.16	−0.15	0.49	−0.07
2002	1.04	0.15	0.15	−0.14	0.49	−0.07
2003	1.07	0.15	0.16	−0.13	0.50	−0.07
2004	1.07	0.15	0.16	−0.13	0.49	−0.06
2005	1.09	0.15	0.16	−0.11	0.49	−0.06
2006	1.10	0.14	0.16	−0.11	0.48	−0.05
2007	1.19	0.13	0.15	−0.09	0.46	−0.04
2008	1.21	0.13	0.16	−0.07	0.47	−0.03
2009	1.21	0.12	0.15	−0.07	0.50	−0.04
2010	1.23	0.12	0.14	−0.08	0.48	−0.04
2011	1.23	0.11	0.14	−0.07	0.47	−0.03
2012	1.22	0.12	0.14	−0.07	0.49	−0.03
2013	1.21	0.12	0.14	−0.07	0.50	−0.04
2014	1.23	0.11	0.14	−0.07	0.49	−0.03
2015	1.22	0.11	0.14	−0.07	0.48	−0.03
2016	1.23	0.12	0.14	−0.07	0.48	−0.03
2017	1.24	0.12	0.14	−0.07	0.48	−0.03
2018	1.23	0.12	0.14	−0.07	0.48	−0.03
2019	1.23	0.11	0.14	−0.06	0.48	−0.03

Note. The contributions to the total size of the automatic stabilizers are calculated by multiplying each elasticity in a given year with its weight (GDP share) in the same year.

Sources: Statistics Sweden and own calculations.

Table 5 summarizes how the different taxes and primary expenditures contribute to the overall budget elasticity (i.e., to the size of the automatic stabilizers), and how these contributions have evolved over time.

Table 5 Automatic stabilizers 1998–2019

Elasticity

	Direct taxes on labour	Payroll tax	Corporate income tax	Indirect taxes	Primary expenditure	Automatic stabilizers
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
1998	0.18	0.12	0.04	0.14	−0.08	0.55
1999	0.17	0.12	0.04	0.14	−0.08	0.56
2000	0.16	0.12	0.05	0.14	−0.08	0.56
2001	0.16	0.13	0.04	0.13	−0.07	0.53
2002	0.15	0.13	0.03	0.13	−0.07	0.51
2003	0.16	0.12	0.03	0.13	−0.07	0.51
2004	0.16	0.12	0.04	0.13	−0.06	0.51
2005	0.16	0.12	0.05	0.14	−0.06	0.52
2006	0.16	0.12	0.05	0.14	−0.05	0.52
2007	0.15	0.12	0.05	0.14	−0.04	0.51
2008	0.16	0.12	0.04	0.14	−0.03	0.48
2009	0.15	0.12	0.04	0.14	−0.04	0.49
2010	0.14	0.11	0.05	0.14	−0.04	0.48
2011	0.14	0.11	0.04	0.14	−0.03	0.47
2012	0.14	0.12	0.04	0.14	−0.03	0.47
2013	0.14	0.12	0.04	0.14	−0.04	0.47
2014	0.14	0.12	0.04	0.14	−0.03	0.47
2015	0.14	0.12	0.04	0.14	−0.03	0.47
2016	0.14	0.12	0.04	0.15	−0.03	0.49
2017	0.14	0.12	0.04	0.15	−0.03	0.49
2018	0.14	0.12	0.04	0.14	−0.03	0.48
2019	0.14	0.12	0.04	0.14	−0.03	0.47

Note. Column (vi) shows the size of the automatic stabilizers calculated as the sum of columns (i)-(iv) less column (v).

Source: Own calculations.

The calculations show that the size of the automatic stabilizers has decreased up until 2011 and has remained relatively unchanged since then (see table 5). The reduction in the automatic stabilizers prior to 2011 is mainly due to a decreasing contribution from direct taxes on labour and from primary expenditure. The lower contribution from direct taxes on labour is due to a reduction in these taxes as a share of GDP. The effect on the automatic stabilizers of lower taxes on labour has in part been counteracted by an increased progressivity in the taxation of labour income, in particular as a result of the design of the earned income tax credit (see the three leftmost columns in table 4).

The lower contribution from primary expenditure is mainly due to lower unemployment benefits as a share of GDP.

4 Robustness tests

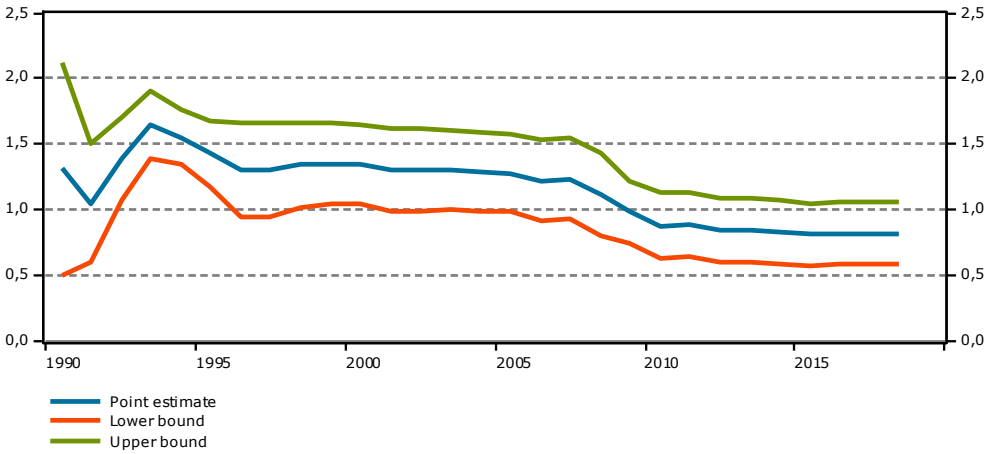
Our robustness tests focus on six areas; (i) the sample length, i.e. which time period is used for estimation of the elasticities of the tax bases and of unemployment with respect to the GDP gap, (ii) the income distribution used for estimation of the elasticities between direct taxes on labour and the labour cost share, (iii) accounting for the extensive margin of labour supply, in relation to the elasticity between tax direct tax on labour and the labour cost share, (iv) the definition of the labour cost share and the profit share, (v) the inclusion of so called semi-automatic stabilizers, and (vi) how uncertainty from the underlying regressions add up to uncertainty around our baseline estimates of the overall budget elasticity.

4.1 Sample length

The estimate of the elasticity of the labour cost share with respect to the GDP gap is sensitive to what time period is used when calculating it (see table 12 in the appendix). As mentioned previously, this might reflect institutional changes in Sweden during recent decades.

One way to assess the sensitivity of our estimates to the time period used is to gradually increase the sample and see how the point estimate changes. We take the subsample 1982-1990 as our starting point and add one year at a time up to 2019. We use the same specification as in the baseline specification. Analyzing the data this way indicates that the elasticity of the labour cost share with respect to the GDP gap changed around the financial crisis but not during the 1990s (see figure 7).

Figure 7 The elasticity between the labour cost share and the GDP gap with different samples



Note. The lower and upper bounds are computed as one standard error around the point estimate.

Source: Own calculations.

We use a Quandt-Andrews-test to formally test for structural breaks in the time series between 1982 and 2019, using the same specification as in the baseline estimates. The reported F-statistic is 7.80, which means that the test rejects the hypothesis that no structural breaks occurred.[32] This lends support the view that the elasticity of the labour cost share and the GDP gap for the Swedish economy may have changed after the 1980s, even though it is hard to pin down an exact year when a change occurred.

As a robustness test of the baseline estimates we calculate the automatic stabilizers by using elasticities estimated on data from 1998, when a new framework for collective wage bargaining (in Swedish: *industriavtalet*) was introduced, to 2019. In the baseline calculations the elasticity between the labour cost share and the GDP gap was estimated on data from 1982 to 2019, which gave 0.82. When estimated over the subsample from 1998 to 2019 it is 0.55. The elasticity between unemployment and the GDP gap is -6.06 in the baseline calculations. When estimated over the subsample from 1998 to 2019 it is –3.78. In both cases, using the shorter sample generates smaller estimated elasticities, which reduces the contributions to the total fiscal automatic stabilizer from direct taxes on labour, payroll tax and the from the elasticity of primary expenditures with respect to the GDP gap. However, the contribution from corporate tax is somewhat large. The new contributions, as well as the automatic stabilizers, can be seen in table 6 below.

[32] We trim of 15 percent of the data in the beginning and the end of the time period. The test is statiscially significant at the one percent level.

Table 6 Automatic stabilizers 1998–2019 based on estimates using only data from 1998 and onwards

Elasticity

	Direct taxes on labour (i)	Payroll tax (ii)	Corporate income tax (iii)	Indirect taxes (iv)	Primary expenditure (v)	Automatic stabilizers (vi)
1998	0.12	0.08	0.05	0.14	−0.05	0.44
1999	0.11	0.08	0.06	0.14	−0.05	0.45
2000	0.11	0.08	0.08	0.14	−0.05	0.46
2001	0.11	0.08	0.05	0.13	−0.05	0.42
2002	0.10	0.08	0.04	0.13	−0.04	0.40
2003	0.11	0.08	0.04	0.13	−0.04	0.41
2004	0.11	0.08	0.06	0.13	−0.04	0.42
2005	0.11	0.08	0.07	0.14	−0.04	0.43
2006	0.10	0.08	0.07	0.14	−0.03	0.43
2007	0.10	0.08	0.08	0.14	−0.03	0.43
2008	0.11	0.08	0.06	0.14	−0.02	0.40
2009	0.10	0.08	0.06	0.14	−0.02	0.40
2010	0.10	0.08	0.07	0.14	−0.02	0.40
2011	0.09	0.08	0.06	0.14	−0.02	0.39
2012	0.09	0.08	0.05	0.14	−0.02	0.39
2013	0.09	0.08	0.06	0.14	−0.02	0.39
2014	0.09	0.08	0.06	0.14	−0.02	0.39
2015	0.09	0.08	0.06	0.14	−0.02	0.40
2016	0.10	0.08	0.06	0.15	−0.02	0.41
2017	0.10	0.08	0.06	0.15	−0.02	0.41
2018	0.09	0.08	0.07	0.14	−0.02	0.40
2019	0.09	0.08	0.06	0.14	−0.02	0.40

Note. Column (vi) shows the size of the automatic stabilizers calculated as the sum of columns (i)-(iv) less column (v).

Source: Own calculations.

Using a shorter sample has a fairly large effect: the size of the automatic fiscal stabilizers is reduced in size by about one fifth compared to our baseline calculation. The downward trend, mainly observed during the first half of the period, is attenuated compared to the baseline.

Even though there are several factors that changed after the crisis that occurred in Sweden in the 1990s it is hard to pin down what has changed that affects the mechanism of how the labour cost share changes over the business cycle. An alternative interpretation is that the underlying functioning of the economy is the same but the two major shocks

that have hit the Swedish economy since the 1980s, the crisis in the 1990s and the financial crisis that started in 2008, are different and that difference drives the results. The crisis in the 1990 was domestic and caused by an uncompetitive economy and unsustainable public finances, whereas the financial crisis was foreign and the Swedish economy was strong enough to be relatively unaffected by the shock. As a consequence the willingness to hoard labour may have been stronger after the financial crisis in 2008 compared to the crisis in the 1990s (Hassler, 2010).

4.2 The distribution of household income

The elasticity between direct tax on labour and the labour cost share is calculated under the assumption that all workers are employed and all wages increase proportionally. The assumption is standard in the literature, but two objections can be made against it. First, the income of low-paid workers typically changes more over the business cycle, so the change in the labour cost is driven by changes in the left tail of the income distribution. Since low-and high-income workers face different (marginal and average) tax rates the elasticity of direct labour taxes with respect to the labor share is skewed and depends on the cut-offs of the income distribution. Second, part of the change in labour costs stems from (low-paid) workers moving in and out of unemployment, rather than employed workers earning more. Because of the earned income tax credit the marginal tax rate differs between unemployment-related transfers and wage income.

To our knowledge there are no empirical findings that clarify what factors drive the change in the labour cost. For that reason, we investigate how the assumptions about the income distribution affect the size of the automatic stabilizers. In the following section we investigate the importance of the flows between employment and unemployment.

In the baseline calculations we assumed that all employed workers, regardless of their place in the income distribution, were affected in the same way by the business cycle. Now we instead assume that changes in labour costs stem from workers on the left side of the income distribution. Instead of using an income distribution that ends with eight times the median wage, as in the baseline calculations, we cut the income distribution at 0.25, 0.50, 0.75, 1.00, and 2.00 times the median wage and assume that the left section is the only part of the distribution that experiences changes to labour income. Within these subsets we maintain the assumption that all wages change proportionally. The corresponding elasticities are shown in table 7.

Table 7 The elasticity of direct taxes on labour with respect to the labour cost share under different assumptions regarding the income distribution

Elasticity

Cut-off:	0.25	0.50	0.75	1.00	2.00	8.00 (Baseline)
1998	1.58	1.04	1.10	1.15	1.27	1.26
1999	1.55	1.02	1.12	1.15	1.23	1.24
2000	1.55	1.01	1.13	1.16	1.24	1.25
2001	1.62	1.02	1.16	1.18	1.24	1.26
2002	1.70	1.04	1.18	1.20	1.25	1.27
2003	1.98	1.20	1.28	1.26	1.29	1.30
2004	2.07	1.21	1.29	1.27	1.29	1.30
2005	1.92	1.24	1.33	1.29	1.32	1.32
2006	1.86	1.28	1.36	1.31	1.34	1.34
2007	4.62	1.83	1.60	1.46	1.46	1.44
2008	6.15	1.97	1.64	1.48	1.50	1.47
2009	6.66	2.01	1.69	1.51	1.48	1.47
2010	6.37	2.03	1.72	1.53	1.50	1.50
2011	6.06	2.02	1.70	1.52	1.50	1.49
2012	5.99	2.02	1.70	1.52	1.48	1.49
2013	5.78	2.01	1.69	1.51	1.47	1.48
2014	5.44	1.93	1.70	1.53	1.49	1.49
2015	5.08	1.92	1.68	1.51	1.48	1.49
2016	4.58	1.91	1.65	1.49	1.50	1.50
2017	4.37	1.91	1.64	1.48	1.50	1.50
2018	4.24	1.90	1.63	1.47	1.50	1.50
2019	4.09	1.80	1.62	1.47	1.49	1.50

Note. The cut-off represents a multiple of the median wage above where no effect of the GDP gap on wage income occurs, as described in the text. The elasticities used in the baseline calculations are reported in the final column.

Source: Own calculations.

The table shows that there is a large difference in the estimated elasticity from 2007 and forward if the cut-off is 25 percent of the median wage compared to if it is 50 percent or larger. This is due to the earned income tax credits which changed the average tax to less than five percent for the income group with a wage less than 25 percent of the median wage.

Even though differences also result using cutoffs at higher points in the distribution, they are relatively small and, given the overall uncertainty inherent in these kinds of ex-

ercises, not that important. When the cut-off is 50 percent of the median wage the elasticity is slightly smaller than the baseline estimates in the first half of the period studied, and from 2007 and onwards the elasticity is larger. The difference peaks in 2009, at around 0.5, and decreases slightly in the end of the period. In 2019 the elasticity is 1.80, a difference of 0.3 compared to the baseline. When the cut-off is twice the median income the elasticity is virtually identical to the baseline estimates.

Using 1.80 as the elasticity of direct taxes on labour income (cut-off at 50 percent of the median) with respect to the labour cost instead of 1.50 (the baseline estimate) for 2019 would increase the budget elasticity only marginally, from 0.47 to 0.50. Moreover, the automatic stabilizers are stable during the studied period under this assumption, as can be seen in the third column in table 11. Hence, allowing for variability only in the lower part of the income distribution decreases the estimated size of the automatic stabilizers slightly compared to our baseline estimates in the beginning of the time period, but increases the size slightly from 2007 and onwards.

4.3 Accounting for labour supply at the extensive margin

The Swedish earned income tax credit[33] means that wages are taxed at lower average and marginal tax rates compared to unemployment benefits. This strengthens incentives to work, but also affects the size of the elasticity of tax revenues with respect to the GDP gap. We perform robustness tests in which workers are assumed to be unemployed for a part of the year, to see how the elasticity of direct labour taxes with respect to the labour cost is affected by introducing an extensive margin in this manner. During unemployment we assume that workers receive 80 percent of their previous wage in unemployment benefits that are eligible for taxes but not for the earned income tax credit. We focus on low-income workers, and look at the two cases where variability of incomes occurs only below a cut-off of the income distribution at 50 percent of the median and at the median.

Being unemployed part of the year reduces overall income for that year. Hence, the marginal tax is lower, which decreases the elasticity of direct tax on labour income with respect to the labour cost share. At the same time the workers' average tax is higher, as unemployment benefits are taxed higher than wage income, which further decreases the

[33] In Swedish: *Jobbskatteavdrag*.

elasticity of direct tax on labour with respect to the labour cost share. We show the elasticity for four new cases in table 8.

Table 8 The elasticity of direct labour taxes with respect to the labour cost share under different assumptions regarding unemployment and the income distribution

Elasticity

Cut-off	0.50			1.00			
	Full-time employed	Unemp. 3 months	Unemp. 6 months	Full-time employed	Unemp. 3 months	Unemp. 6 months	Baseline
1998	1.04	1.12	1.22	1.15	1.20	1.26	1.26
1999	1.02	1.10	1.19	1.15	1.21	1.27	1.24
2000	1.01	1.09	1.17	1.16	1.22	1.28	1.25
2001	1.02	1.09	1.18	1.18	1.24	1.31	1.26
2002	1.04	1.11	1.20	1.20	1.26	1.33	1.27
2003	1.20	1.27	1.36	1.26	1.33	1.41	1.30
2004	1.21	1.27	1.35	1.27	1.34	1.42	1.30
2005	1.24	1.30	1.38	1.29	1.37	1.46	1.32
2006	1.28	1.34	1.41	1.31	1.39	1.48	1.34
2007	1.83	1.64	1.46	1.46	1.48	1.33	1.44
2008	1.97	1.73	1.48	1.48	1.50	1.37	1.47
2009	2.01	1.71	1.41	1.51	1.50	1.32	1.47
2010	2.03	1.63	1.32	1.53	1.50	1.27	1.50
2011	2.02	1.62	1.31	1.52	1.49	1.27	1.49
2012	2.02	1.61	1.31	1.52	1.49	1.27	1.49
2013	2.01	1.60	1.31	1.51	1.49	1.28	1.48
2014	1.93	1.56	1.26	1.53	1.47	1.20	1.49
2015	1.92	1.54	1.26	1.51	1.46	1.21	1.49
2016	1.91	1.53	1.30	1.49	1.45	1.24	1.50
2017	1.91	1.51	1.29	1.48	1.45	1.24	1.50
2018	1.90	1.50	1.29	1.47	1.44	1.25	1.50
2019	1.80	1.48	1.27	1.47	1.42	1.18	1.50

Note. The first three columns show the results where variation in incomes only occur below 50 percent of the median wage. The following three columns show the results when variation in incomes only occur below themedian wage. The elasticities used in the baseline calculations are reported in the final column.

Source: Own calculations.

As shown in table 8, assumptions about the extensive margin affect the elasticity between direct taxes on labour with respect to the labour cost share differently before and after 2007, which is the year in which the earned income tax credit was first introduced. Before 2007 the elasticity increases with the assumed time in unemployment, because

longer time in unemployment results in a lower average tax rate and hence higher elasticity. After the introduction of the earned income tax credit the marginal tax rate decreases with the assumed time in unemployment, because the tax credit, in relation to the wage earned, is larger for small wages. Hence, an unemployed worker, who gets less wage and more unemployment benefits, faces a lower marginal tax rate. This results in a smaller elasticity of direct taxes on labour with respect to the labor cost share. However, the difference compared to the baseline estimates is relatively small. For example, using 1.18 as the elasticity for 2019 (cut-off at the median wage and unemployed for 6 months), instead of 1.50 (the baseline estimate), reduces the overall budget elasticity only marginally, by 0.03. The automatic stabilizers for all years under this assumption can be seen in the fourth column in Table 8. The table shows that accounting for the extensive margin decreases the size of the automatic stabilizers by around 0.03 from 2007 and onwards. This assumption results in a slightly larger decrease of the size of the automatic stabilizers during the studied period, compared to the baseline estimates.

4.4 Alternative definition of the labour and profit shares

The definitions of the income shares that are used in the baseline calculations are broad definitions based on macroeconomic aggregates. Alternatively, one could use definitions from the national accounts. As a robustness test, we define labour costs as the wage sum, and profits as the corporate tax revenue divided by the corporate tax rate of the same year. We then estimate the elasticities between the labour cost share and the business cycle as done previously. Since the new definitions of labour cost and profits do not add up to total GDP we estimate the elasticity between the profit share and the business cycle directly using OLS and the same specification as for the labour cost. Due to lack of data, we only perform the regressions on the time period 1998–2019.

The new elasticity of the labour cost share with respect to the business cycle is 0.44, with a standard error of 0.13, which is lower than the baseline estimate (0.82) and the results using the previous definition of labour costs restricted to data from 1998–2019 (0.55). A lower elasticity results in a lower contribution to the size of the automatic stabilizers from both direct taxes on labour and payroll tax.

The elasticity between the profit share and the business cycle is substantially higher with the new definition compared to the previous definition. It is now 3.79, with a standard error of 1.38, which is substantially higher than the elasticity used in the baseline calculation (1.46) and the robustness test where the elasticity is estimated using data from

1998–2019 (2.16). This means that the contribution to the size of the automatic stabilizers from corporate income tax is higher using this definition, compared to the baseline estimation.

The unemployment-related transfers that were included in the baseline calculations were unemployment insurance and compensation for participants included in labour market programs. There are other transfers in Sweden that are not directly linked to unemployment but are still expected to vary with the unemployment rate, most notably welfare benefits that are disbursed to workers that do not qualify for unemployment benefits, and income-based housing allowances.[34] Resource assistance and housing allowance amount to roughly half the value of the unemployment-related transfers used earlier, although the ratio has varied over time, from 30 percent in 2004 to 70 percent in 2008. We show the size of the automatic stabilizers with the new definitions of income shares, as well as the inclusion of these transfers, in table 9.

[34] In Swedish: *försörjningsstöd* and *bostadsbidrag*. We only include the part of the housing allowance that is paid to families and not the part that is paid to retired people.

Table 9 Automatic stabilizers 1998–2019 using definitions of labour costs and profits from the national accounts and broader measures of unemployment-related transfers

Elasticity

	Direct taxes on labour	Payroll tax	Corporate income tax	Indirect taxes	Primary expenditure	Automatic stabilizers
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
1998	0.09	0.07	0.09	0.14	−0.07	0.46
1999	0.09	0.07	0.11	0.14	−0.07	0.48
2000	0.09	0.07	0.13	0.14	−0.07	0.50
2001	0.09	0.07	0.09	0.13	−0.06	0.44
2002	0.08	0.07	0.07	0.13	−0.06	0.41
2003	0.09	0.07	0.08	0.13	−0.06	0.42
2004	0.09	0.06	0.10	0.13	−0.05	0.44
2005	0.09	0.06	0.13	0.14	−0.05	0.46
2006	0.08	0.06	0.13	0.14	−0.04	0.46
2007	0.08	0.06	0.14	0.14	−0.04	0.46
2008	0.08	0.06	0.10	0.14	−0.03	0.42
2009	0.08	0.06	0.10	0.14	−0.03	0.42
2010	0.08	0.06	0.12	0.14	−0.03	0.43
2011	0.07	0.06	0.11	0.14	−0.03	0.42
2012	0.08	0.06	0.09	0.14	−0.03	0.40
2013	0.08	0.06	0.10	0.14	−0.03	0.41
2014	0.07	0.06	0.10	0.14	−0.03	0.41
2015	0.07	0.06	0.11	0.14	−0.03	0.42
2016	0.08	0.06	0.11	0.15	−0.03	0.43
2017	0.08	0.06	0.11	0.15	−0.03	0.43
2018	0.08	0.06	0.11	0.14	−0.03	0.43
2019	0.07	0.06	0.11	0.14	−0.03	0.42

Note. Column (vi) shows the size of the automatic stabilizers calculated as the sum of columns (i)-(iv) less column (v).

Source: Own calculations.

Using definitions from the national accounts reduces the contributions to the automatic stabilizers from direct taxes on labour and payroll tax, compared to the robustness test where the standard definitions were used and the underlying elasticities were estimated using data from 1998-2019. By contrast, the contribution from corporate income tax is larger than in the previous robustness test. The contribution from primary expenditures is also slightly larger than in the previous robustness test and the total size of the automatic stabilizers is marginally higher (see column (ii) and (iv) in table 11). For 2019, the last year of the sample, the difference amounts to about 0.03.

4.5 Semi-automatic stabilizers

In our baseline calculations, unemployment insurance and compensation for participants in labour market programs are the only primary expenditures that vary automatically with the business cycle. If enrolment rates for active labour market programs go up, expenditure on the associated benefits increases automatically, and hence these benefits are considered to be automatic stabilizers. But if the change in enrolment is large, the government would likely also have to spend money to expand the size of the active labour market programs to accommodate the increase in enrolment. This, however, requires an active decision and is not considered to be an automatic stabilizer. But if this form of expenditure is closely linked to changes in unemployment, it could be included in a broader measure of automatic stabilizers, and is sometimes referred to as a semi-automatic stabilizer. Flodén (2009) calculates a broader measure of automatic stabilizers that encompasses this form of expenditure.

In this section, we present data on active labour market programs (ALMP) expenditures from the period 1998–2018.[35] Data show that the relationship between expenditure on ALMP and the GDP gap is not as straightforward as one might expect. This casts some doubt on the reliability of empirical estimates of semi-automatic stabilizers in Sweden. We then present a point estimate of the size of the semi-automatic stabilizers.

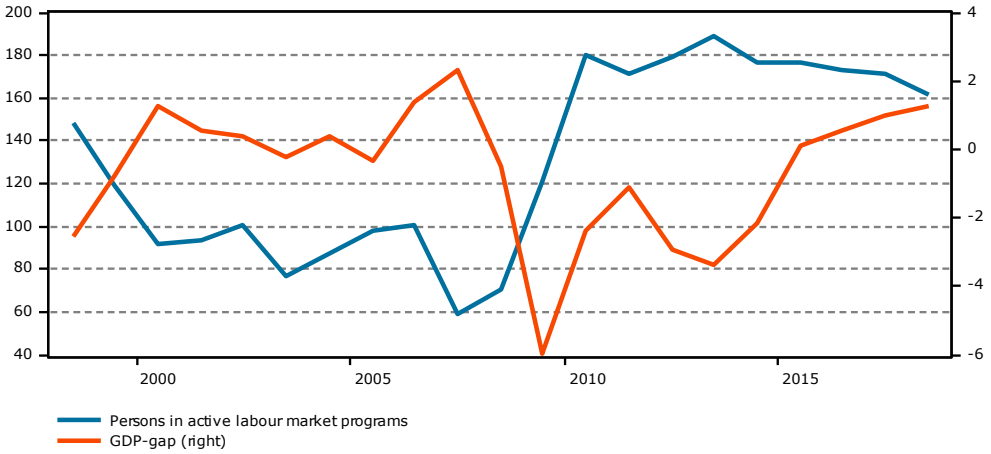
The number of persons involved in ALMP has varied over time (see figure 8).[36] However, running a regression with the *expenditures* on ALMP as the dependent variable and the previous year's GDP gap as explanatory variable does not yield significant coefficient estimates. As shown in figure 9, these expenditures showed a declining trend up to 2007 and an increasing trend thereafter, but expenditure does not closely mirror the pattern for enrolment in ALMP. This indicates that expenditure on ALMP is not solely driven by changes in the state of the economy but also by other political considerations.

[35] The data is provided by the Swedish Public Employment Service.

[36] There is a negative correlation between the number of persons in ALMP and the GDP gap where a larger GDP gap implies fewer involved. The correlation is -0.42 using the current year's GDP gap and -0.62 using the previous year's GDP gap based on data between 1998 and 2018.

Figure 8 Active labour market programs

Thousands and percent

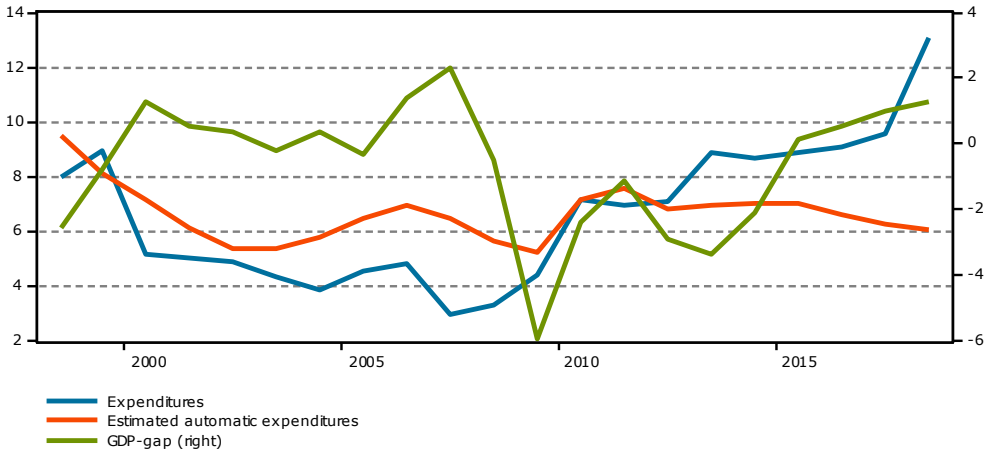


Sources: Swedish Public Employment Service and NIER.

To isolate the share of the expenditures of ALMP that are due to unemployment and not reflecting other political priorities, we estimate a regression where the expenditures depend on the current and the previous year's unemployment rate (see figure 9). This captures expenditures that are driven by changes in unemployment but not other political decisions. The regression shows that 15 percent of the variation in the expenditures for ALMP can be explained by the unemployment rate. The remainder, in our view, should be treated as a discretionary expenditure, and not included in estimates of automatic stabilizers even when these are broadly defined.

Figure 9 Automatic expenditures on active labour market programs

SEK Billions and percent



Sources: Swedish Public Employment Service and NIER.

Nonetheless, the data indicate that there is a part of expenditure for ALMP that closely follows changes in unemployment. Including an estimate of this semi-automatic stabi-

lizer increases the contribution to the size of automatic stabilizers from public expenditures, compared to our baseline calculations, as shown in table 10. Widening the measure of automatic stabilizers to account for semi-automatic stabilizers has only a modest effect on the estimates (0.03 in 1998 and 0.01 2018). This is a considerably smaller contribution than that estimated by Flodén (2009), which was based on a shorter sample. In our view, the data do not support the view that these expenditures can be assumed to make a clear contribution to a broad measure of automatic stabilizers in Sweden. This does not preclude an important role for active labour market programs. But the data suggest that such expenditures should be considered to be largely discretionary.

A back of the envelope calculation supports our view that semi-automatic stabilizers make a relatively modest contribution to automatic stabilizers. The Swedish labour force was approximately 5 million individuals in 2018. About half of the unemployed participated in active labour market programs (ALMP). We have previously estimated that a one percent decline in GDP increases the unemployment rate by roughly 0.4 percentage points, which corresponds to about 20 000 individuals in 2018. If half of these enter an ALMP, enrolment increases by 10 000 persons. According to our baseline calculations, the inclusion of ALMP increases the size of the automatic stabilizers by about 0.01. This would imply an additional 0.01 percent of GDP in the response on automatic stabilizers, or about 0.5 billion SEK in 2018. For an increase in ALMP enrolment of 10 000 to cost 0.5 billion SEK (only counting overhead costs, i.e. excluding compensation paid directly to participants), the cost for an additional participant needs to be 50 000 SEK. In practice, these costs vary a great deal depending on the exact details of the labour market program, but during 2014-2018 the average cost for a participant in ALMP was slightly less than 60 000 SEK, indicating that our conclusion is reasonable.[37]

[37] The numbers of participants in ALMP and the cost of the programs can be seen in Figure 8 and Figure 9.

Table 10 Semi-automatic stabilizers 1998–2018

Percent and elasticity respectively

	$(1-\tau_{\bar{w}})\frac{\sigma}{G}$	ALMP/G	Sum/G	$\frac{U^*}{U}$	Elasticity γ_g	Contribution	Automatic stabilizers
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
1998	3.1	0.9	3.9	0.8	3.2	−0.10	0.58
1999	2.7	0.7	3.4	0.9	3.3	−0.10	0.58
2000	2.5	0.6	3.1	1.1	3.5	−0.10	0.58
2001	2.0	0.5	2.5	1.2	3.1	−0.09	0.55
2002	2.0	0.4	2.4	1.2	2.8	−0.09	0.52
2003	2.1	0.4	2.5	1.1	2.6	−0.08	0.53
2004	2.2	0.4	2.6	0.9	2.5	−0.07	0.53
2005	2.2	0.4	2.6	0.9	2.3	−0.07	0.54
2006	1.9	0.5	2.4	0.9	2.3	−0.07	0.53
2007	1.3	0.4	1.7	1.1	1.9	−0.05	0.52
2008	1.0	0.4	1.4	1.1	1.5	−0.04	0.49
2009	1.5	0.3	1.8	0.8	1.5	−0.04	0.49
2010	1.6	0.4	2.1	0.8	1.6	−0.05	0.49
2011	1.4	0.4	1.8	0.9	1.5	−0.04	0.48
2012	1.4	0.4	1.8	0.8	1.5	−0.04	0.48
2013	1.4	0.4	1.8	0.8	1.5	−0.05	0.48
2014	1.3	0.4	1.7	0.8	1.4	−0.04	0.48
2015	1.2	0.3	1.6	0.9	1.4	−0.04	0.48
2016	1.2	0.3	1.5	1.0	1.5	−0.04	0.50
2017	1.1	0.3	1.4	1.0	1.4	−0.04	0.50
2018	1.0	0.3	1.3	1.1	1.4	−0.04	0.49

Note. Column (i) shows net unemployment-related transfers as share of primary expenditures. Column (ii) shows expenditures on active labour market programs as share of primary expenditures and column (iii) shows total expenditures due to unemployment, i.e. the sum of colum (i) and (ii) as share of primary expenditures. Column (iv) shows the inverted unemployment gap. Column (v) shows the elasticity of primary expenditures on unemployment related transfers including ALMP, net of taxes, with respect to the unemployment gap, which is obtained by multiplying columns (iii) and (iv). Column (vi) shows how the primary expenditures contributes to the automatic stabilizers, and corresponds to the fifth column in Table 5 (the baseline calculation). (Column (vii) shows the size of the semi-automatic stabilizers.

Sources: Ministry of Employment, Statistics Sweden and NIER.

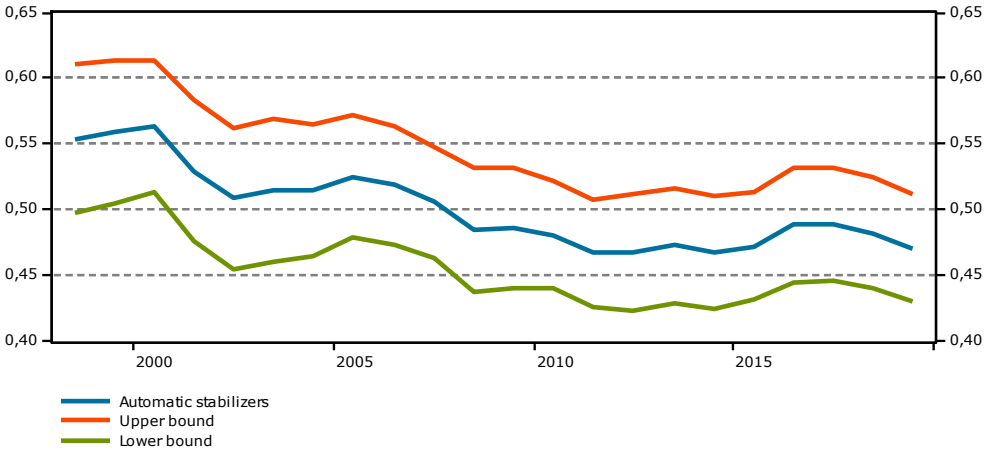
4.6 Uncertainty from the OLS estimates

When calculating the size of the automatic stabilizers, we use a number of point estimates from OLS regressions. As shown in table 12 and table 13, the point estimates (of the elasticity of the labour cost share and the elasticity of the unemployment gap with respect to the GDP gap) are significantly different from zero, but the standard errors are non-negligible. The uncertainty surrounding the point estimates carries over into uncertainty surrounding our overall calculations.

To evaluate the importance of this uncertainty we estimate the elasticity of the labour cost share with respect to the GDP gap, as well as the elasticity of the unemployment gap with respect to the GDP gap simultaneously using data from 1982 to 2019, the same period used in the baseline estimation. We then use the variance from the multivariate regression to compute a confidence band around the estimate of the size of the automatic stabilizers, see figure 10. The lower and upper band is one standard deviation away from the point estimate, which provides a 68 percent confidence interval.

Figure 10 Confidence band around the size of the automatic stabilizers

Elasticity



Note. The upper and lower confidence bound is one standard deviation away from the point estimate, providing a 68 percent confidence interval.

Source: Own calculations.

As figure 10 shows the confidence interval is approximately 0.1. The trend, with a falling budget elasticity, is unaffected but the figure shows that the point estimate should be interpreted with caution. The lower- and upper bound are presented in columns (vii) and (viii) in table 11.

4.7 Conclusions from the robustness tests

The results from the different robustness tests described above are summarized in table 11. The overall conclusion is that our main results appear to be reasonably robust. The size of the automatic stabilizers has decreased somewhat in Sweden during the period 1998-2019. The exact amount depends on the assumptions made but the decrease is a little bit more than 0.05, corresponding to about one tenth of the size of the automatic stabilizers at the outset of the period studied. The decline occurs mainly in the first half of the sample. Using alternative specifications has modest effects on the overall size of the fiscal stabilizers.

Table 11 Automatic stabilizers under different assumptions

Elasticity

	Baseline	Data 1998-2019	Income distri-bution	Extensive margin	Definitions	ALMP	Lower bound	Upper bound
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
1998	0.55	0.44	0.52	0.55	0.46	0.58	0.50	0.61
1999	0.56	0.45	0.53	0.56	0.48	0.58	0.50	0.61
2000	0.56	0.46	0.53	0.57	0.50	0.58	0.51	0.61
2001	0.53	0.42	0.50	0.54	0.44	0.55	0.48	0.58
2002	0.51	0.40	0.48	0.51	0.41	0.52	0.45	0.56
2003	0.51	0.41	0.50	0.53	0.42	0.53	0.46	0.57
2004	0.51	0.42	0.50	0.53	0.44	0.53	0.46	0.57
2005	0.52	0.43	0.52	0.54	0.46	0.54	0.48	0.57
2006	0.52	0.43	0.51	0.53	0.46	0.53	0.47	0.56
2007	0.51	0.43	0.55	0.49	0.46	0.52	0.46	0.55
2008	0.48	0.40	0.54	0.47	0.42	0.49	0.44	0.53
2009	0.49	0.40	0.54	0.47	0.42	0.49	0.44	0.53
2010	0.48	0.40	0.53	0.46	0.43	0.49	0.44	0.52
2011	0.47	0.39	0.52	0.45	0.42	0.48	0.43	0.51
2012	0.47	0.39	0.52	0.45	0.40	0.48	0.42	0.51
2013	0.47	0.39	0.52	0.45	0.41	0.48	0.43	0.52
2014	0.47	0.39	0.51	0.44	0.41	0.48	0.42	0.51
2015	0.47	0.40	0.51	0.45	0.42	0.48	0.43	0.51
2016	0.49	0.41	0.53	0.46	0.43	0.50	0.44	0.53
2017	0.49	0.41	0.53	0.46	0.43	0.50	0.44	0.53
2018	0.48	0.40	0.52	0.46	0.43	0.49	0.44	0.52
2019	0.47	0.40	0.50	0.44	0.42		0.43	0.51

Note. Column (i) shows the size of the automatic stabilizers from the baseline calculations and column (ii) shows the same using only data from 1998-2019. Column (iii) shows the calculations where the income distribution is truncated at 50 percent of the median wage. Column (iv) shows the size of the automatic stabilizers assuming income variability only occurs in incomes below the median wage and the workers are assumed to be unemployed for six months. The calculations underlying colum (v) uses alternative definitions of labour costs, profit share and unemployment-related transfers as described in the text. Column (vi) shows includes the semi-automatic stabilizers, where the expenditures for active labour market programs are included. Finally, columns (vii) and (viii) show the confidence bounds of one standard deviation around the baseline estimate that stems from the regressions.

Source: Own calculations.

5 Discussion

Our key finding is that the implementation of policies to make work pay have not impaired automatic fiscal stabilizers to any great extent, reflecting the way these reforms were designed. This applies particularly to the earned income tax credit introduced in 2007 and expanded in several steps over the following years.

The method used treats the budget elasticity with respect to the GDP gap as a measure of the size of automatic stabilizers. Although the method is widely used there are important caveats, since there is uncertainty about the size of the budget elasticity.[38] As the analysis has shown the estimated budget elasticity varies depending on the time period used to estimate the elasticities between the labour market share and the GDP gap, as well as between the unemployment gap and the GDP gap. The estimates are to a large extent driven by two major shocks, namely the crisis in the 1990s and the financial crisis starting in 2008. At the same time, the Swedish economy has undergone significant structural change. However, the overall conclusion that the implementation of policies to make work pay have not impaired automatic fiscal stabilizers to any great extent, remains in all our robustness test.

To make predictions about how changes in the GDP gap affect the fiscal balance, we recommend using a value of 0.5 for the budget elasticity, based, in part, on data going back to 1982. Whether it is better to use longer time series that stretch further back in time, or narrowing the sample to use only more recent data, is an open question. If one prefers using only the more recent data our calculations support values in the range of 0.4-0.5 for the budget elasticity. We caution against using larger values that assume a large contribution from semi-automatic stabilizers, since the data available today do not support this view.

[38] Another caveat is that the size of the automatic stabilizers might not be fully captured by the method used in this study. As pointed out by Portes and Wren-Lewis (2015), the design of fiscal frameworks can affect automatic stabilizers. Changes to the fiscal framework in Sweden, such as a new surplus target and a possibility for the municipalities to smooth their results, might affect the fiscal stabilizers even though it does not affect the budget elasticity.

6 References

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7 Appendix

7.1 Derivation of the budget elasticity

Let S denote the public sector's budget balance, T_i income from tax i, G primary expenditures by the public sector, X the net of auxiliary income and expenditures (mainly capital income, interest rate expenditures and income from capital depreciation[39]) and let Y denote GDP in current prices. The budget balance can then be computed as[40]

$$S = \sum_i T_i - G + X. \tag{12}$$

Let lowercase letters denote shares of GDP.[41] That gives

$$s = \frac{S}{Y} = \frac{\sum_i T_i - G + X}{Y}. \tag{13}$$

The budget balance is affected by the state of the economy. Let $*$ denote the underlying, structural, variables which are adjusted for the business cycle. That gives that S^* is the cyclically adjusted budget balance and Y^* is potential GDP. The cyclically adjusted budget balance as a share of GDP can then be computed as

$$s^* = \frac{S^*}{Y^*} = \frac{\sum_i T_i^* - G^* + X^*}{Y^*} \tag{14}$$

where T_i^* are the structural tax revenues and G^* is the total of structural primary expenditures. The structural net of auxiliary income and expenditures is assumed to be the same as the actual, $X^* = X$, so in the following calculations X is used to denote both the structural and the actual net of auxiliary income and expenditures.[42]

Let s' denote the part of the budget balance as a share of GDP that depends on the business cycle. That gives

$$s = s^* + s'. \tag{15}$$

Let the GDP gap be $\frac{(Y-Y^*)}{Y^*}$. Assume that s' is proportional to the GDP gap, by a factor α, then

$$s = s^* + \alpha\left(\frac{Y - Y^*}{Y^*}\right) \tag{16}$$

[39] The national accounts define capital depreciation as an income since investments decreases the budget balance immediately.

[40] All variables in the following equations are for the same year. Hence, we exclude time indices.

[41] This is different compared to the section "Methods and data" where lowercase letters denoted the logarithm.

[42] A monetary policy with inflation targeting as its goal may in theory result in procyclical interest rate expenditures for the public sector. This effect is disregarded in the following calculations, partly due to the fact that the public sector in Sweden has positive net wealth.

where α represents the size of the *automatic fiscal stabilizers*.

How the budget balance is affected by a change in GDP is given by the derivative of s with respect to Y. That gives

$$\frac{\partial s}{\partial Y} = \alpha \frac{1}{Y^*} \tag{17}$$

Which can be rewritten as

$$\alpha = \frac{\partial s}{\partial Y} Y^* \tag{18}$$

and since GDP is generally close to potential GDP we can make an approximation $Y \approx Y^*$ so

$$\alpha \approx \frac{\partial s}{\partial Y} Y. \tag{19}$$

The expression above shows that the size of the automatic fiscal stabilizers, α, can be calculated as a semi-elasticity of the budget balance with respect to the state of the economy (measured as the GDP gap). This (semi-)elasticity is also called the *budget elasticity* with respect to GDP and shows how much the budget surplus changes, as a percentage share of GDP, when the GDP gap changes by one percentage point.

To derive a formula for α it is assumed that the relationship between actual and structural tax revenues can be calculated according to

$$T_i = \left(\frac{Y}{Y^*}\right)^{\varepsilon_i} T_i^* \tag{20}$$

where ε_i is the elasticity of tax revenue i with respect to GDP. The corresponding expression for the primary expenditures is

$$G = \left(\frac{Y}{Y^*}\right)^{\gamma} G^* \tag{21}$$

where γ is the elasticity of primary expenditures with respect to GDP. This means that

$$T_i^* = \left(\frac{Y}{Y^*}\right)^{-\varepsilon_i} T_i \tag{22}$$

and

$$G^* = \left(\frac{Y}{Y^*}\right)^{-\gamma} G. \tag{23}$$

Expanding the expression $s' = s - s^*$ gives

$$s' = s - s^* = \frac{\sum_i T_i - G + X}{Y} - \frac{\sum_i T_i^* - G^* + X}{Y^*} \tag{24}$$

where we substitute in the expressions for T_i^*och G^*.

So s' can be written as[43]

$$s' = \frac{\sum_i \left[1 - \left(\frac{Y}{Y^*}\right)^{1-\varepsilon_i}\right] T_i - \left[1 - \left(\frac{Y}{Y^*}\right)^{1-\gamma}\right] G + \left[1 - \left(\frac{Y}{Y^*}\right)\right] X}{Y}. \tag{25}$$

The derivative of s' with respect to Y shows how the share of the budget balance that depends on the state of the economy changes when the state of the economy changes, so

$$\begin{aligned}\frac{\partial s'}{\partial Y} = &\frac{\sum_i \left[-(1-\varepsilon_i)\left(\frac{Y}{Y^*}\right)^{-\varepsilon_i}\frac{1}{Y^*}\right] T_i \times Y - \sum_i \left[1 - \left(\frac{Y}{Y^*}\right)^{1-\varepsilon_i}\right] T_i}{Y^2} \\ &- \frac{\left[-(1-\gamma)\left(\frac{Y}{Y^*}\right)^{-\gamma}\frac{1}{Y^*}\right] G \times Y - \left[1 - \left(\frac{Y}{Y^*}\right)^{1-\gamma}\right] G}{Y^2} \\ &+ \frac{\left[-\frac{1}{Y^*}\right] X \times Y - \left[1 - \left(\frac{Y}{Y^*}\right)\right] X}{Y^2}.\end{aligned} \tag{26}$$

We evaluate the expression above when $Y = Y^*$

$$\left.\frac{\partial s'}{\partial Y}\right|_{Y=Y*} = \frac{\sum_i [-(1-\varepsilon_i)] T_i}{Y^2} - \frac{-(1-\gamma)G}{Y^2} + \frac{-X}{Y^2} \tag{27}$$

$$\left.\frac{\partial s'}{\partial Y}\right|_{Y=Y*} = \frac{\sum_i [(\varepsilon_i - 1)] T_i}{Y^2} - \frac{(\gamma - 1)G}{Y^2} + \frac{-X}{Y^2} \tag{28}$$

and $s = 0$, which gives[44]

$$\left.\frac{\partial s'}{\partial Y}\right|_{Y=Y*} = \frac{\sum_i \varepsilon_i T_i}{Y^2} - \frac{\gamma G}{Y^2}. \tag{29}$$

Earlier we concluded that $\alpha = \frac{\partial s'}{\partial Y} Y$. This means that the budget elasticity can be written as

$$\alpha = \sum_i \varepsilon_i \frac{T_i}{Y} - \gamma \frac{G}{Y}. \tag{30}$$

Hence, the budget elasticity with respect to GDP can be calculated as the sum of the elasticity for each tax, weighted with that tax share of GDP, minus the elasticity of primary expenditures, weighted with primary expenditures' share of GDP.

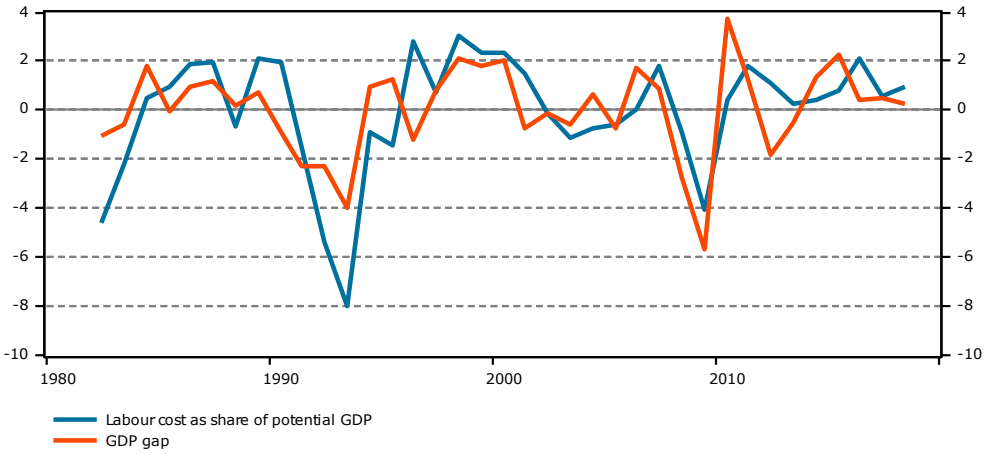
[43] We use the fact that $\frac{A}{B} = \frac{A}{B}\frac{C}{C} = \frac{A}{C}\frac{C}{B} = \frac{A(\frac{C}{B})^1}{C}$.

[44] That $s = 0$ means that $\sum_i T_i - G + X = 0$ which is the same as $\sum_i -T_i + G - X = 0$.

7.2 Graphs and tables

Figure 11 Change in the labour cost as share of potential GDP and change in the GDP gap

Change in percentage points



Note. The series are used to estimate the elasticity of the labour cost share with respect to the GDP gap, and correspond to the dependent variable as well as the independent variable from equation (4).

Source: NIER and own calculations.

Table 12 Estimated elastitcity of the labour cost share with respect to the GDP gap

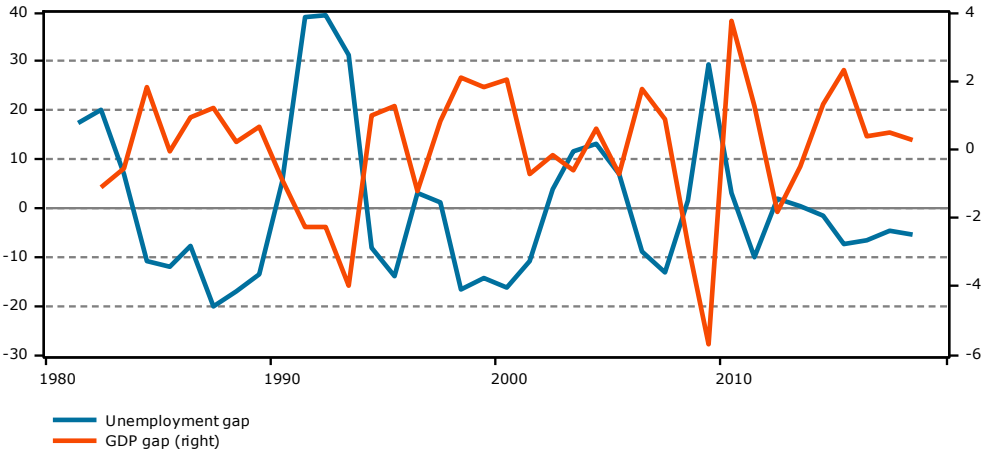
	Elasticity	Standard error
1982–2007	1.23	(0.31)
1982–2019	0.82	(0.24)
1990–2007	1.16	(0.37)
1990–2019	0.77	(0.24)
1998–2019	0.55	(0.12)
2008–2019	0.49	(0.13)

Note. The regressions are estimated with OLS and Newey-West standard errors. The coefficients are significant at the 1 percent level in all specifications. The Durbin-Watson test indicates that the serial correlation in the error term is small.

Source: Own calculations.

Figure 12 Change in the unemployment gap and change in the GDP gap

Change in percentage points



Note. The series are used to estimate the elasticity of the unemployment gap with respect to the GDP gap, and correspond to the dependent variable as well as the independent variable from equation (5).

Source: NIER and own calculations.

Table 13 Estimated elasticity between the unemployment gap and the GDP gap

	Elasticity	Standard error
1982–2007	–9.60	(1.27)
1982–2019	–6.06	(1.71)
1990–2007	–9.22	(1.19)
1990–2019	–5.66	(1.68)
1998–2019	–3.78	(0.74)
2008–2019	–3.07	(0.74)

Note. The regressions are estimated with OLS and Newey-West standard errors. The coefficients are significant at the 1 percent level in all specifications. The Durbin-Watson test indicates that the serial correlation in the error term is small.

Source: Own calculations.