HOW DIFFERENT PUBLIC EXPENDITURE PROGRAMS AFFECT UNEMPLOYMENT RATES

The relationship between public expenditure, particularly unemployment benefits, and labor market dynamics has been the focus of extensive academic inquiry. This paper aims to explore how unemployment benefits and other forms of public expenditure affect the unemployment rate, analyzed at a country level, through the computation of a linear regression model, from which we will be able to extract meaningful insights to develop an analysis to potentially guide policymakers in developing public expenditure policies that maximize households' welfare while minimizing market distortions and negative externalities caused by these expenditures.

Valentino Agazzi Mandozzi

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Contact: agazzimandozzivalentino@gmail.com

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INTRODUCTION AND PREVIOUS LITERATURE:

Unemployment benefits play a crucial role in safeguarding workers' incomes and maintaining consumption levels during periods of joblessness. The IZA World of Labor (2024) emphasizes that these benefits act as automatic stabilizers during economic downturns, preventing severe reductions in aggregate demand. However, the potential for prolonged unemployment spells and a modest increase in the national unemployment rate due to generous benefits must be considered. This dual role of unemployment benefits—providing essential income support while potentially influencing job search behavior—is a recurring theme in the literature.

The impact of unemployment benefits on job search intensity and unemployment duration has been extensively studied. For instance, Faberman and Ismail (2020) from the Chicago Federal Reserve demonstrate that individuals receiving unemployment insurance benefits tend to search more intensely for jobs compared to those who have exhausted their benefits or did not receive any. This finding challenges the conventional notion that unemployment benefits reduce job search effort, suggesting instead that benefits sustain higher search intensity until exhaustion.

Further complexities arise when considering the macroeconomic effects of benefit extensions. The Federal Reserve Bank of New York (2024) provides a nuanced understanding of how extended benefits during the Great Recession increased equilibrium wages, reduced job vacancies, and ultimately raised the unemployment rate. This highlights the importance of considering equilibrium effects when designing unemployment benefit policies, as benefit extensions can contribute to higher unemployment rates during economic downturns.

The interaction between benefit duration and job finding rates is also critical. The Spanish Public Employment Service (2024) reveals that receiving unemployment benefits can delay job finding, with significant variations observed across different phases of the business cycle. Notably, the study highlights an "exhaustion effect," where job finding rates accelerate as individuals near the end of their benefit period. This illustrates the complex interplay between benefit duration and job search intensity, underscoring the importance of timing in benefit design.

Comparative analyses of different unemployment compensation systems further enrich this discussion. The International Labor Review (2000) contrasts unemployment assistance schemes with unemployment insurance schemes, revealing that the latter, when financed through worker contributions, can support income without exacerbating unemployment. This distinction is crucial, as general revenue-funded benefits tend to increase wages and reduce labor demand, whereas contribution-based systems maintain a neutral effect on these variables.

METHODOLOGY AND DATA:

In order to add some value to this discussion, I will shift the focus of the study and analyze the effects of unemployment benefits and other types of public expenditure on the unemployment rate. To do this, I will conduct a short but intensive analysis of data from different sources, such as the World Bank Database and the OECD Database, at a country level. The idea is to perform a linear regression model, taking the unemployment rate as the explained variable. As a consequence of this, we will be able to analyze whether the impact of explanatory variables, such as cash/kind transfers to households, public spending on unemployment benefits, unemployment benefits as a percentage of previous income after 2/6 months and 1/2/5 years, and many others, is positive or negative, large or small, and statistically significant or not.

In terms of the process prior to the analysis, that is to say, the process of cleaning and manipulating the data to make it apt for analysis, it is important to mention that the variable average wage, or just wage, is not specifically the average wage but the average income of the citizens of that specific country and year. Apart from this, the NaN values are going to be handled through a process of linear interpolation and filling the remaining ones (those that are at the top and bottom of the table and that cannot be interpolated) with the average values for their countries. If there are any remaining NaN values after this process, the observation is going to be dropped. The code will be available, and the data frames will also be published in Excel format so that everybody can replicate this analysis. Besides this, we have to consider that we are dealing with data that presents many variables expressed in different magnitudes, which might make it difficult to build a linear regression. To deal with this problem, I will standardize the data (subtract the mean and divide it by the standard deviation), bringing all the data to a single scale. How to interpret the results obtained through the regression will be explained afterward.

HYPOTHESIS AND PREDICTIONS:

To begin with, considering the previous literature on the topic, I have learned that unemployment benefits are helpful in protecting workers from selling assets in order to afford periods of unemployment. Moreover, the time they spend unemployed helps them to search for offers that better fit their skills, thereby increasing the efficiency of the market. However, according to the same literature, unemployment benefits are also known to generate a discouraging effect on workers. Therefore, my first hypothesis is that the more extended unemployment benefits are over time, the more they will discourage citizens from joining the labor force and increase unemployment.

Secondly, I presume in advance that different forms of public expenditure will have different effects on unemployment. Indirect forms of spending (such as in-kind transfers) are less discouraging for people to search for employment and may even be negatively correlated with unemployment. Conversely, direct injections of income into the population (such as a minimum vital income, direct cash transfers, and so on) are likely to be highly related to discouraging behavior and higher levels of unemployment.

Finally, it is logical to think that variables increasing the marginal value of one extra hour devoted to work will have a negative effect when explaining unemployment. Therefore, it is easy to predict that some variables, such as the average wage (recall that this variable stands for the average income), will have a negative effect on unemployment. Conversely, some variables that directly shorten the time workers are able to stay in a particular job position will positively contribute to unemployment. These variables are captured by temporary employment as a percentage of full employment.

RESEARCH INSIGHTS AND RESULTS:

As I previously explained, the main objective of this research process is to study and explain the effects of different forms of public expenditure on unemployment through the development of a linear regression model, which can be observed next.

OLS Regression Results

Dep. Variable:	unemployment_rate	R-squared:	0.403
Model:	OLS	Adj. R-squared:	0.397
Method:	Least Squares	F-statistic:	64.35
Date:	Wed, 03 Jul 2024	Prob (F-statistic):	1.15e-102
Time:	16:07:11	Log-Likelihood:	-1264.8
No. Observations:	1100	AIC:	2552.
Df Residuals:	1089	BIC:	2607.
Df Model:	10		
Covariance Type:	HC3		

	coef	std err	z	P>|z|	[0.025	0.975]
const	-2.064e-16	0.023	-8.86e-15	1.000	-0.046	0.046
average_wage	-0.2022	0.033	-6.215	0.000	-0.266	-0.138
in_cash_transfers_households	0.2164	0.031	6.940	0.000	0.155	0.278
in_kind_transfers_households	0.0702	0.028	2.511	0.012	0.015	0.125
public_spending_unemployment_benefits	0.3732	0.035	10.660	0.000	0.305	0.442
public_spending_family_benefits	-0.1177	0.034	-3.467	0.001	-0.184	-0.051
social_public_spending	0.0933	0.040	2.331	0.020	0.015	0.172
min_inc_as_per_of_med_inc_single_NC	0.1022	0.027	3.846	0.000	0.050	0.154
temp_employment_as_per_employment	0.1474	0.024	6.179	0.000	0.101	0.194
unemployment_benefits_as_per_previos_inc_2M	-0.1030	0.032	-3.196	0.001	-0.166	-0.040
unemployment_benefits_as_per_previos_inc_1Y	0.1467	0.033	4.399	0.000	0.081	0.212

Omnibus:	24.424	Durbin-Watson:	0.445
Prob(Omnibus):	0.000	Jarque-Bera (JB):	44.303
Skew:	0.129	Prob(JB):	2.40e-10
Kurtosis:	3.949	Cond. No.	3.17

Notes:
[1] Standard Errors are heteroscedasticity robust (HC3)

Regarding its computation method, note that the covariance is heteroscedasticity consistent three (HC3). This is due to the detection of possible heteroscedasticity problems in the model through the computation of all the classical heteroscedasticity detection methods: the Breusch-Pagan Test (Lagrange multiplier statistic: 36.438, p-value: 7.07e-05, f-value: 3.731, f p-value: 6.08e-05), the Goldfeld-Quandt Test (f-value: 1.155, p-value: 0.047), and the White Test (Test Statistic: 168.323, Test Statistic p-value: 4.20e-11, f-value: 2.874, f p-value: 2.72e-12). However, even after applying the most aggressive estimator of the covariance, the statistical significance of the values of β_i remained intact.

Secondly, considering possible heterogeneity, I initially thought it would be a good idea to develop a fixed effects model with dummy variables for each country. However, I noticed that none of these remained statistically significant, and therefore, preserving the original model previously presented was a better idea.

Finally, referring to autocorrelation, we must understand that autoregressive processes are quite common when dealing with time series data for several reasons. Summarizing, these can be enumerated in the following list:

- **Economic Persistence and Momentum**: Economic variables like GDP and average wages tend to remain at similar levels over time because of the economy's inertia. For instance, if a country's GDP was high last year, it's likely to stay high this year too. This happens because the factors driving economic growth, like investments and consumer spending, don't change quickly.
- **Lagged Effects of Economic Policies**: Policies take time to show their full impact on the economy. For example, if the government cuts interest rates, it can boost investments and spending, but these effects spread out over several months or even years. This means changes in policy today can affect GDP and wages in the future, creating a lagged, autocorrelated effect.
- **Structural Economic Relationships**: Economic variables are often linked together. For instance, GDP components such as consumption, investment, and government spending are interconnected. If consumption goes up, it can push GDP higher. Similarly, wages are influenced by factors like demand for labor and productivity, which are themselves autocorrelated. These interdependencies create autocorrelation in the data.
- **Trend and Seasonality**: Economic data often show clear trends and seasonal patterns. For example, GDP might steadily grow over the years due to technological advancements and population growth. Additionally, certain times of the year, like the holiday season, can cause regular ups and downs in economic activity. These trends and seasonal effects naturally lead to autocorrelation in the data.

This might not necessarily be negative. However, if we intend to be more statistically rigorous, we might try to solve the problems of autocorrelation with the Cochrane-Orcutt method, through which we will obtain the following model:

Estimated rho: 0.49470392196226165

OLS Regression Results

Dep. Variable:	unemployment_rate	R-squared:	0.321
Model:	OLS	Adj. R-squared:	0.317
Method:	Least Squares	F-statistic:	42.53
Date:	Thu, 04 Jul 2024	Prob (F-statistic):	3.14e-53
Time:	19:26:26	Log-Likelihood:	-844.99
No. Observations:	1099	AIC:	1706.
Df Residuals:	1091	BIC:	1746.
Df Model:	7		
Covariance Type:	HC3		

	coef	std err	z	P>|z|	[0.025	0.975]
const	-0.0004	0.031	-0.012	0.991	-0.062	0.061
average_wage	-0.2114	0.033	-6.460	0.000	-0.276	-0.147
in_cash_transfers_households	0.2233	0.029	7.667	0.000	0.166	0.280
public_spending_unemployment_benefits	0.3078	0.038	8.174	0.000	0.234	0.382
min_inc_as_per_of_med_inc_single_NC	0.0793	0.024	3.241	0.001	0.031	0.127
temp_employment_as_per_employment	0.0768	0.025	3.122	0.002	0.029	0.125
unemployment_benefits_as_per_previos_inc_2M	-0.0597	0.030	-2.024	0.043	-0.118	-0.002
unemployment_benefits_as_per_previos_inc_1Y	0.0993	0.033	2.989	0.003	0.034	0.164

Omnibus:	146.657	Durbin-Watson:	1.010
Prob(Omnibus):	0.000	Jarque-Bera (JB):	1640.640
Skew:	-0.008	Prob(JB):	0.00
Kurtosis:	8.986	Cond. No.	2.31

Notes:
[1] Standard Errors are heteroscedasticity robust (HC3)

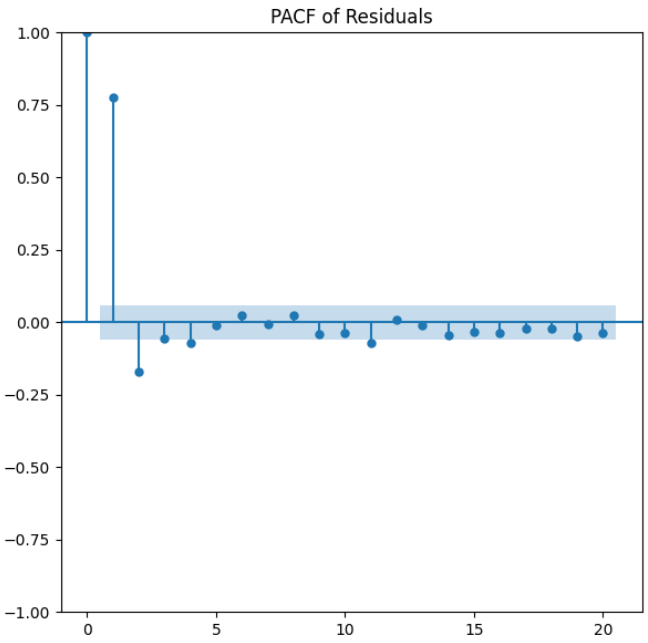
As we can observe, both models are similar but present visible differences regarding some explanatory variables that had to be dropped since they remained statistically insignificant after the application of the Cochrane-Orcutt method to deal with autocorrelation. As we can see, the Durbin-Watson indicator improved; however, it is far from a value equal to 2, or at least greater than 1.723, which is the critical value of ((D_l) for $\alpha = 0.05$, with which we would reject autocorrelation for the model. Note that the persistent autocorrelation is actually a positive autocorrelation, providing evidence about the type of autocorrelation process (AR) previously mentioned.

Since the previous attempt to get rid of autocorrelation remained unsuccessful, I tried to compute a GLS model with the Prais-Winsten method. However, while the Durbin-Watson indicator improved by approximately 1.5 points (which is still not enough to reject autocorrelation), I had to drop many variables because the aggressive transformations over the

model made it impossible to build a consistent model. To address the problem of autocorrelation, we must understand the negative implications this characteristic might bring to the model. Autocorrelation usually causes the estimated standard errors of the regression coefficients to be biased. This bias leads to incorrect conclusions about the statistical significance of the predictors. Specifically, when there's positive autocorrelation, the standard errors are often underestimated. This underestimation increases the likelihood of Type I errors, which means we're more likely to find a predictor statistically significant when it's not. Because the standard errors are biased, the t-tests for individual regression coefficients and the F-tests for overall model significance can become invalid. The p-values from these tests can be misleading because they're based on the assumption that the errors are independent, which isn't the case when autocorrelation is present. Finally, and as we might suspect, this issue also affects the confidence intervals computed. The biased standard errors cause them to be incorrectly sized. They can be either too narrow or too wide, but with positive autocorrelation, they're typically too narrow. This misestimation means that the confidence intervals might not capture the true parameter values as frequently as they should.

To address this issue, I will opt for the Newey-West standard errors. Essentially, Newey-West standard errors adjust for both autocorrelation and heteroscedasticity by modifying the covariance matrix of the error terms. This adjustment leads to more accurate standard errors, making our statistical tests, the p-values we get for our regression coefficients, and therefore the statistical significance of our predictors reliable. Moreover, the confidence intervals become correctly sized, accurately reflecting the true parameter values.

The Newey-West procedure starts by estimating the autocovariances of the residuals up to the specified number of lags. These autocovariances measure how much the residuals at different time points are related to each other. The issue here is how to choose the correct number of lags. In this case, I consider that the most appropriate procedure, statistically speaking, would be to plot the Partial Autocorrelation Function and observe at which point the autocorrelation among the observations shifted a certain number of times (lags) becomes insignificant. The purpose here is to minimize the number of lags while minimizing the autocorrelation of the observations. As we can observe in the following plot, the point (lags) where we achieve this objective is at two, where the correlation coefficient becomes lower than 0.2.



Now that we know the appropriate number of lags to apply, we have everything we need to finally get rid of autocorrelation and heteroscedasticity all at once. We can observe the result of adding the newly more sophisticated standard errors to the model. As we appreciate, the p-value of most of the estimators of the predictors has increased; however, all of them remain statistically significant at least for $\alpha = 0.1$. Moreover, the adjusted R^2 also remained intact compared to the original model. Now that we have a strong model robust to both heteroscedasticity and autocorrelation, we can analyze and interpret the results obtained.

First of all, we must consider that the variables are standardized, so the interpretation of the coefficients obtained for each variable changes, so in order to properly understand the model, we must first understand how to interpret the value of the coefficients for each variable. Consider that, when a variable is standardized, we are going to be speaking in terms of standard deviations. Therefore, we will say, for instance, that an increase of **one standard deviation** in a specific variable, take as an example, **average wage** (where $\beta_{average\ wage} = -0.2022$), is going to, in this specific case, decrease the value of the dependent variable, **unemployment rate**, by 0.2022 standard deviations. To make it clearer, imagine that $\sigma_{average\ wage} = 1000$ units, and that $\sigma_{unemployment\ rate} = 0.06$ or 6%. In our model filled by standardized variables, the correct interpretation will be that an increase in wages by one standard deviation (1000 units), is going to decrease the dependent variable, unemployment, by 0.2022 times its standard deviation (0.06 or 6%). As a result, the effect of this operation is going to be equal to $-0.2022 * 6\% = -1.2132\%$, and how do we interpret this? We could say that *"an increase of wages by 1000 units decreases unemployment by 1.21%"*.

OLS Regression Results

Dep. Variable:	unemployment_rate	R-squared:	0.403
Model:	OLS	Adj. R-squared:	0.397
Method:	Least Squares	F-statistic:	34.32
Date:	Thu, 04 Jul 2024	Prob (F-statistic):	2.08e-58
Time:	22:59:47	Log-Likelihood:	-1264.8
No. Observations:	1100	AIC:	2552.
Df Residuals:	1089	BIC:	2607.
Df Model:	10		
Covariance Type:	HAC		

	coef	std err	t	P>|t|	[0.025	0.975]
const	-2.064e-16	0.036	-5.79e-15	1.000	-0.070	0.070
average_wage	-0.2022	0.047	-4.287	0.000	-0.295	-0.110
in_cash_transfers_households	0.2164	0.043	5.085	0.000	0.133	0.300
in_kind_transfers_households	0.0702	0.040	1.739	0.082	-0.009	0.149
public_spending_unemployment_benefits	0.3732	0.047	7.896	0.000	0.280	0.466
public_spending_family_benefits	-0.1177	0.046	-2.544	0.011	-0.208	-0.027
social_public_spending	0.0933	0.053	1.763	0.078	-0.011	0.197
min_inc_as_per_of_med_inc_single_NC	0.1022	0.037	2.755	0.006	0.029	0.175
temp_employment_as_per_employment	0.1474	0.034	4.372	0.000	0.081	0.214
unemployment_benefits_as_per_previos_inc_2M	-0.1030	0.048	-2.134	0.033	-0.198	-0.008
unemployment_benefits_as_per_previos_inc_1Y	0.1467	0.050	2.956	0.003	0.049	0.244

Omnibus:	24.424	Durbin-Watson:	0.445
Prob(Omnibus):	0.000	Jarque-Bera (JB):	44.303
Skew:	0.129	Prob(JB):	2.40e-10
Kurtosis:	3.949	Cond. No.	3.17

Notes:
[1] Standard Errors are heteroscedasticity and autocorrelation robust (HAC) using 2 lags and without small sample correction

Now that we know the theoretical framework we can proceed to interpret the model. To start, we can focus on the sign of the β coefficient for each variable in order to understand if the effect is positive or negative and develop an economic intuition afterwards. Let's start with the **average wage**, which, remember, in fact, references the average income of each country's people. We already talked about its negative incidence over unemployment and how to interpret its beta coefficient, however, we have not developed any explanation behind this result. It is not such a great finding to remark that the greater the salaries are, the more incentives citizens are going to have to find a job instead of staying unemployed. However usually huge salaries are the result of a great demand of labor in comparison to the demand, so this phenomenon is also captured by the parameter beta. At the end, these are the two possible interpretations, that however, are not incompatible and do not exclude each other.

Secondly, consider the variables **in-cash and in-kind transfers to households**. It seems that both contribute positively to increasing unemployment, and it actually makes a lot of sense. If the government transfers resources to households, these will have less incentives to work. Of course, the final decision of joining or not the labor market, will depend on the particular

circumstances of each individual, however, what the model is telling us is that in those countries with higher amounts of transfers of resources to households present greater rates of unemployment. Now, leaving this aside, I would like to focus on the differences among the values of these estimators. As we can see, $\beta_{in-cash\ transfers} = 0.2164$ while $\beta_{in-kind\ transfers} = 0.0702$, what means that the effect of in-cash transfers is actually more than three times bigger than in-kind transfers. Recalling my initial hypothesis, whether it is true that for a moment I thought that in-kind transfers were not going to have a positive effect over unemployment, it remained true that its effect is lower than the one generated by in-cash transfers to households. The economic intuition that we can derive from this is that in-cash transfers do not consider the differences among the needs of individuals, what would force them to work in the case that they have other needs besides the ones covered by the in-kind transfers supplied by government, however, if they receive a transfer by the same amount in-cash terms, they are able to allocate it in a more efficient way, allowing them not to work in some cases, or to report that they are unemployed in order to receive more of this kind of transfers. Thanks to this conclusion, we can understand that if government wants to maximize households' welfare without discouraging employment, in-kind transfers are a better option.

Thirdly, let's consider **government expenditure on unemployment benefits**. Just by a rapid analysis, it seems that the mere amount of money spent by the government on unemployment benefits positively contributes to an increase in unemployment. However, we must be careful and more sophisticated here, since two possible interpretations are feasible. To begin with, we might understand that higher unemployment benefits might incentivize workers to stay registered as unemployed, however, it would also make so much sense to think that those countries with higher unemployment records will spent more in unemployment just by pure definition, so we might consider that the estimator of $\beta_{public\ ex.\ on\ unemp.\ benefits}$ actually captures both phenomena. On the other hand, if we take a rapid look to the estimator of β_i for the variables unemployment **benefits as percentage of previous income by after 2 months/1 year**, we will notice that a higher amount of income after two months of being unemployed not only does not contribute to increase unemployment, but actually depletes it, while an increase in the unemployment benefits after one year is in fact correlated with higher levels of unemployment rates. This information contributes to validate not only my initial hypothesis, but all the previous literature mentioned in the introduction. It seems that those countries that provide their workers with greater unemployment benefits in the first two months present lower levels of unemployment, while in contrast, those that provide huge amounts after one year in fact exhibit greater rates.

To finalize the interpretation chapter, we will focus all at once on the remaining ways of public expenditure. Let us start with the most intuitive coefficient, the **minimum income as percentage of the medium income of a person that is single and has no child**. As we can observe, minimum income programs seem to contribute to increased unemployment since it is a feature of high unemployment countries. Minimum income, defined as transfers to joblessness families intuitively might incentivize staying registered as unemployed, since at the end of the day is like an in-cash injection to households, which will be taken away if they get into

a job. Next, we have **public spending on family benefits**, that seems to have a negative impact on unemployment. We can intuitively justify these negative effects over unemployment if we properly analyze these types of programs in OCDE countries. For instance, in Spain and some other European Union countries, family benefits take the form of tax deductions, special discount for large families or single parent families, special discount on some public services and subventions for some private services, and so on. For sure, some in-cash transfers might be included, however these are not usually the main sources of benefits for families, so intuitively its logical to understand why this kind of transfers do not discourage working habits of the family members. Moreover, these plans usually are designed to reduce the financial stress of families and avoid one parent to stay at home taking care of children by encouraging the consumption of daycare services and providing contractual benefits such as maternity/paternity leaves, making it easier for workers to keep their current position and avoiding them to be forced to leave due to their parental condition. Furthermore, some family benefit programs are designed with work incentives, such as benefits that increase with employment or are only available to working families. These incentives can motivate parents to enter or remain in the workforce.

To summarize our findings, we can state that short-term unemployment benefits, in-kind transfers, and supportive family benefits are helpful tools to maintain or even lower unemployment rates while at the same time we contribute to improve the welfare of households. However, on the other hand, we have explored how long-term benefits and direct cash transfers tend to increase it. Therefore, policymakers to consider these insights when designing optimal public spending programs to support employment and economic stability while they look for the improvement of the living conditions of people.

CONCLUSION:

This study sets out to explore how different types of government spending affect unemployment rates. The main focus was on unemployment benefits, in-kind transfers, direct cash transfers, minimum income programs, and family benefits. The hypotheses were that extended unemployment benefits would discourage people from looking for jobs, indirect spending would have less of a discouraging effect compared to direct cash transfers, and higher wages would lead to lower unemployment. The results confirmed that short-term unemployment benefits help people find jobs and reduce unemployment, while long-term benefits are linked to higher unemployment rates. Indirect spending, like in-kind transfers, didn't discourage job searching as much as direct cash transfers, which were associated with higher unemployment rates. Higher average wages were found to lower unemployment, and temporary employment was linked to higher unemployment rates. Spending on family benefits generally helped reduce unemployment by easing financial stress and supporting working parents through tax deductions and discounts. Moreover, minimum income programs were also linked to higher unemployment rates, as they worked as a monetary incentive that would be taken away from households if they found a job.

These findings suggest that policymakers should consider the implications of public expenditure on such an important macroeconomic indicator as the unemployment rate and therefore make use of less distorting tools when looking to improve the well-being of households. Particularly, in-kind transfers, short-term unemployment compensations, and family benefits seem to be the best candidates for accomplishing this task in the most efficient and effective way possible. However, when analyzing the findings of this article, we must consider that due to the technological limitations of data recording, there could be unobserved factors that affect the results. Future research, which will hopefully benefit from improved technology that allows for the collection of more detailed and specific data, should look into these factors more deeply and consider different economic contexts to make the conclusions more robust and adaptable to particular cases. Future studies should focus on the long-term effects of different types of public spending on the labor market and see how these expenditures work in different economic environments, considering factors such as economic cycles, regional differences, and demographics. Additionally, studying how public spending interacts with other labor market policies could give a more complete understanding of how to improve employment outcomes.

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