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Unemployment fluctuations and the predictability of currency returns

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Abstract

We investigate if unemployment fluctuations generate predictability in the cross-section of currency excess returns. To assess the predictability exerted by unemployment fluctuations, we sort currencies according to past growth in the unemployment rate. We find that an investment strategy which shorts currencies that experienced high growth in the unemployment rate and invests in currencies that experienced low growth in the unemployment rate, produces positive and sizable excess returns. This strategy improves the performance of the optimal portfolio of the currency investor. Moreover, a principal component analysis suggests an interpretation of this strategy as a risk-factor which drives the variability of portfolio average returns. Asset pricing tests show that popular risk factors in the FX literature are not priced in the cross-section of portfolios sorted on past unemployment fluctuations.

JEL classification: F31, F44, E44, G12, G15

Keywords: currency portfolio returns, unemployment fluctuations, predictability, risk-premia, asset pricing

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Introduction

This paper investigates if unemployment fluctuations generate predictability in currency excess returns. The centrality of unemployment related data in driving investors' asset allocation decision along with other macro-factors motivates a better understanding of the empirical relationship between unemployment fluctuations and currency returns. For instance, there is evidence that the release of the US nonfarm payroll figures on the first Friday of each month has an impact on the quotation of the US dollar versus other currencies[1].

Despite we use the US dollar as domestic currency and numeraire, our study takes a broader perspective and it is not based on announcement effects specific to US unemployment data. Instead, our aim is to evaluate if cross-sectional differences across countries concerning unemployment fluctuations are informative about future currency excess returns. For this goal, we adopt a multi-currency set-up in which currencies of a large cross-section of OECD countries are sorted into portfolios. Unemployment fluctuations, measured at the country level, is the conditioning variable according to which we sort currencies and allocate them into the portfolios. Focusing on portfolios has become a common technique since it has the advantage of eliminating the noise inherent to individual currencies (e.g. Lustig and Verdelhan 2007, Lustig et al. 2011, Menkhoff et al. 2012a, 2012b).

The contribution of this paper is purely empirical and we do not have in mind a solid theoretical underpinning which connects unemployment fluctuations and exchange rates. However, to the best of our knowledge, our study is the first to investigate the relationship between unemployment fluctuations and currency returns[2] and our findings could be relevant both for the investment industry but also for academic research in the international finance field which has, traditionally, struggled to reconcile exchange rates with macro-fundamentals. Indeed, we find that currencies associated to past low growth of the unemployment rate provide, on average, higher excess returns than currencies associated to high growth of the unemployment rate.

In order get a better understanding of the statistical properties of the unemployment fluctuation currency portfolio returns, we follow Lustig and Verdelhan (2011)[3] and perform a principal component analysis of the portfolio returns. Intuitively, this allows us to focus on few factors

[1] For an academic reference see, among the others, Faust et al., 2007, which investigates the impact of nonfarm payroll release (and other macro-announcements) on the US dollar. For study a study concerning instead the impact of US monetary policy news see, as an example, Fischer and Ranaldo (2011) who analyze the impact of FOMC news on global FX trading.

[2] Typically, the literature (e.g. Nucci and Pozzolo, 2010, and reference therein) has investigated the impact of currency fluctuations on employment/unemployment but not the other way around.

[3] It is important to remind although that they sort currencies into portfolios on the basis of interest rate differentials, not unemployment fluctuations.

that explain the common variation in returns. Consistently with Lustig and Verdelhan (2011), we identify a *level* factor and a *slope* factor. In particular, the latter accounts for the difference in portfolio average returns and is highly correlated with the high minus low investment strategy, $HML_{\Delta U}$, which shorts currencies characterised by past high growth in the unemployment rate (i.e. *bad* unemployment fluctuations) and invests in currencies characterised by low growth in the unemployment rate (i.e. *good* unemployment fluctuations). On average, this strategy remunerates the investor when business cycle conditions are good but exposes her to losses recessions. This strategy shows annualized average returns equal to 3.7% and a sizable annualized Sharpe ratio equal to 0.46. Hence, both statistical and economic considerations suggest the choice of $HML_{\Delta U}$ as a candidate risk-factor driving the cross-sectional difference in average portfolio returns. Moreover, $HML_{\Delta U}$ has very interesting properties when it is included in the investment set of the currency investor. Indeed, we find that when the currency investor has the possibility to allocate her wealth on the $HML_{\Delta U}$ strategy, the Sharpe ratio of the optimal portfolio (i.e. the global minimum volatility portfolio) is much higher than when this strategy is excluded from her opportunity set.

According to the canonical risk-return trade-off, the variability of portfolio average returns (i.e. risk-premia) should be related to different exposure of these portfolios towards specific risk factors. Hence, in the last part of the paper, we employ a standard asset-pricing framework (i.e. Cochrane, 2005, Burnside, 2011) to understand if popular risk factors in the FX literature might be eligible for the cross-sectional difference in currency risk-premia related to unemployment fluctuations. We start by assessing whether $HML_{\Delta U}$ is priced in the cross-section of currency portfolio returns and then we move to other candidate factors, namely a *carry trade* factor (HML_{FX}, Lustig and Verdelhan, 2011), a *value* factor (HML_{VAL}, Menkhoff et al., 2015, Rafferty, 2011) and a *momentum* factor (HML_{MOM}, Menkhoff et al., 2012b). We find that $HML_{\Delta U}$ is priced in the cross-section of unemployment fluctuation sorted currency portfolios, while the other candidate risk-factors are not. As consequence, the understanding of the sources of risk for which investors demand compensation and which drive differences in portfolio average returns still calls for further research.

The findings of our paper add a contribution to the field of international finance literature that investigates if idiosyncratic sources of risk at the country level generates currency risk-premia and which include e.g. Bansal and Dahlquist (2000). The authors find that cross-sectional differences in currency risk premia are related to country-specific macro attributes. However, while they consider a comprehensive range of macro-factors which include per capita

GNP, average inflation rates, and inflation volatility, they do no take into consideration unemployment fluctuations.

Our work is also related to the literature on currency investment strategies. In particular, our $HML_{\Delta U}$ fills into the category of currency *value* strategies that exploit fundamentals to anticipate future currency returns and which typically employ the level of the real exchange rate to get a measure of the *fundamental value* of a currency (e.g. Menkhoff et al., 2015, Rafferty, 2011), while this paper is the first to propose a value strategy based on unemployment fluctuations.

The paper is organised as follows. Section 2 describes the data, Section 3 presents the results of the empirical analysis, Section 4 performs some robustness checks, and Section 5 concludes.

2 Data and currency portfolios

Our data set uses quarterly observations spanning the period from Q1 1990 to Q4 2013. Subsections 2.1 and 2.2 describe the data used in the empirical analysis. 2.3 explains the computation of currency excess returns. In 2.4 and 2.5 we provide details about the construction of the currency portfolios and the high minus low strategy, $HML_{\Delta U}$, based on the rates of growth of the unemployment rate across countries. Importantly, in 2.6, we show how this strategy adds value to a currency investor that can invest in popular FX investment strategies.

2.1 Data on spot and forward exchange rates

We collect end-of-quarter spot and forward exchange rates vis-á vis the US dollar for a cross-section of 32 OECD countries, namely Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Iceland, Israel, Italy, Japan, South Korea, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, the United Kingdom and the Euro area. Data are collected from Thomson Reuters Datastream and refer to the midpoint between bid rate and the offered rate. After the introduction of the euro in 1999, we remove from our sample the Eurozone countries and replace them with the Euro area.

2.2 Data on unemployment fluctuations

The rate of growth of the unemployment rate, which is the variable that we use to measure unemployment fluctuations, is calculated on the basis of the Harmonised Unemployment Rate (Total-All Persons) available on the OECD web-site[4].

The (annual) rate of growth of the unemployment rate is computed as: $\Delta U_{c,t} = \frac{(U_{c,t} - U_{c,t-4})}{U_{c,t-4}}$ where $U_{c,t}$ is the unemployment rate for country c at quarter t, while $U_{c,t-4}$ is the unemployment rate in the same country at quarter $t-4$. In Table 1, we provide descriptive statistics of the rate of growth of the unemployment rate at the country level. The sample exhibits substantial heterogeneity. For instance, there are countries like Australia and New Zealand which experienced modest unemployment fluctuations (the average rate of growth of the unemployment rate is less than 1% and equal to 1%, respectively, and the volatility is less than 20%) and other countries, like Iceland or Estonia, which, following domestic or global financial crisis, experienced more dramatic fluctuations in the unemployment rate. As a further remark, it is also important to stress that these descriptive statistics suggest that sorting currencies according to the observed unemployment fluctuations might be different than sorting currencies according to safe-haven characteristics (Ranaldo and Soderling, 2010). Indeed, descriptive statistics for countries like Japan and Switzerland, both traditionally considered as *safe-haven* by currency investors, are very different from each other, with Japan showing a more benign picture in terms of unemployment fluctuations with a lower average and less volatile rate of growth of the unemployment rate.

Figure 1 shows the evolution over time of the cross-sectional mean of the rates of growth of the unemployment rate ($\overline{\Delta U}$). This is the mean, computed at each quarter from 1990 Q1 to 2013 Q4, of the rates of growth of the unemployment rate for the cross-section of countries in our sample, i.e $\overline{\Delta U} = \sum_{c=1}^{N} \Delta U_{c,t}$, where N represents the total number of countries for which the rate of growth of the unemployment rate is available at quarter t. The evolution of $\overline{\Delta U}$ provides the basic informative content of unemployment fluctuations. Indeed, $\overline{\Delta U}$ is slowly evolving and displays peaks in correspondence of NBER recessions.

2.3 Currency excess returns

We indicate the spot exchange rate at time t as S_t and the forward exchange rate as F_t. We adopt the perspective of a US investor and express both spot and forward rates as number of

[4]The only exception is Switzerland, for which the Harmonised Unemployment Rate is unavailable at the required frequency. In this case we use the Registered Unemployment Rate instead.

US dollars (USD) for a unit of foreign currency (FCU), i.e. (USD/FCU). Hence, an increase in S_t implies a depreciation of the US dollar and a corresponding appreciation of the foreign currency.

The excess returns on buying a foreign currency in the forward market at time t and selling it in the spot market at time $t+1$ is calculated as:

$$RX_{t+1} = (S_{t+1} - F_t)/S_t$$

If Covered Interest Parity (CIP) holds[5], the forward premium $(S_t - F_t)/S_t$ approximately equals the interest rate differential $i_t^* - i_t$, where i_t and i_t^* indicate the domestic and foreign risk-free rate, respectively. Hence, we can express the currency excess return as the interest rate differential plus the change in the exchange rate, i.e.

$$RX_{t+1} = i_t^* - i_t + (S_{t+1} - S_t)/S_t$$

Following this definition, we can divide the excess returns into two components: the first capturing the interest rate differential and the second capturing the pure exchange rate returns, i.e. the appreciation or depreciation of the foreign currency.

2.4 Unemployment currency portfolios

We form six currency portfolios based on the past rates of growth in the unemployment rates. In particular, at the beginning of each quarter t, we sort currencies on the basis of the corresponding country's rate of growth of the unemployment rate $\Delta U_{c,t-1}$. Then, we place in portfolio one currencies of countries that have experienced the highest growth in unemployment rate, while we place in portfolio six currencies associated to countries that have experienced the lowest growth in unemployment. Finally, we track the performance of the six portfolios over the quarter. At the beginning of quarter $t+1$, we form new portfolios on the basis of new information about the rates of growth of the unemployment rate. As a result, the composition of each portfolios varies over time. We also consider two investments that we label, respectively, as RX and $HML_{\Delta U}$. RX invests equally in each portfolio and provides the return than an investor gets by borrowing in US dollars at the beginning of each quarter and then investing with equal

[5]Given the time-span and the countries analyzed, we consider this as a safe-assumption and we do not expect our sample to be affected by sizable deviation of the CIP (for a list of episodes and currencies for which CIP have failed see Della Corte et al., 2014).

weights in the foreign currencies. $HML_{\Delta U}$ is an investment strategy that goes long in the low unemployment growth portfolio and short the high unemployment growth portfolio. This strategy provides the remuneration that an investor receives should she borrow in the currencies of countries which experienced *bad* unemployment fluctuations and invest in the currencies of countries which experienced *good* unemployment fluctuations.

Table 2 shows descriptive statistics of the six portfolio returns joint with RX and $HML_{\Delta U}$. In general, we find a negative relationship between portfolio returns and past unemployment growth. Indeed, investing in portfolio one (i.e. bad fluctuations) yields an annualized average returns of 1.8 percent while investing in portfolio six (i.e. good fluctuations) yields an annualized average returns of 5.5 percent. The portfolios also differ in terms of annualized Sharpe ratio which generally increases as we move from portfolio one to six.

The observed predictability could be related to a Taylor-rule based explanation according to which sorting currencies on past unemployment fluctuations simply pick up interest rate differentials arising from cross-sectional differences in the inflation rate. To assess if the predictability of sorting currencies according to past unemployment fluctuations arises from the interest rate differential or from the exchange rate component of excess returns, in Table 3 we show descriptive statistics concerning the pure exchange rate component (i.e. exchange rate returns) of the six portfolios. If predictability was non related to the exchange rate returns, we would expect to observe no variation in the average exchange rate returns of the six portfolios. Yet, we do observe variation as portfolio one yields an average exchange rate return equal to -0.006 while portfolio six yields an average exchange rate return equal to 0.035. As a consequence, we can infer that the predictability we exert from unemployment fluctuations do concern future exchange rates appreciation/depreciation.

2.5 The unemployment fluctuation strategy $HML_{\Delta U}$

$HML_{\Delta U}$ yields an annualized average return equal to 3.7 percent and a sizable Sharpe ratio equals to 0.46[6]. In Figure 2 we show the evolution over time of excess returns from $HML_{\Delta U}$. The deepest troughs of the time-series are in correspondence of NBER recession dates[7], thereby suggesting that the excess returns yield by currencies in the long portfolio have a prociclycal nature. A possible explanation behind it is that currencies whose countries have experienced in the past good unemployment fluctuations (i.e. low growth rates in unemployment) are more

[6] As a reference the historical Sharpe ratio of the S&P500 is 0.5.

[7] More precisely, these troughs fall in the 1990-1991 and 2008-2009 recessions, while they slightly anticipate the 2001 recession.

exposed to swings in the business cycle than currencies of countries that have experienced bad unemployment fluctuations (i.e. high growth rates in unemployment) before the occurring of a crisis. In other words, these counties are less exposed to a worsening of the economic conditions being already at the bottom. Put it differently, it is possible that the impact of a recession on the unemployment rate can be asymmetric across countries and that the growth in the unemployment rate following a worsening of the business cycle can be higher for countries that were starting from a lower level of unemployment.

In Figure 3 we plot $HML_{\Delta U}$ joint with the popular carry trade factor HML_{FX} proposed by Lustig and Verdelhan (2011) based on cross-country interest rate differentials. Overall, the two strategies evolve very differently over time and $HML_{\Delta U}$ shows less extreme swings than HML_{FX}.

2.6 The value of the $HML_{\Delta U}$ for the currency investor

Despite its poor performance during NBER recessions, thanks to a favorable correlation structure (see later), the currency investor can still benefit in terms of diversification from the high minus low investment strategy based on unemployment fluctuations. To show that, we construct the optimal currency portfolio for an investor that, in addition to $HML_{\Delta U}$, has at disposal the following three popular currency investment strategies[8]:

1.$\mathbf{HML_{FX}}$: the excess returns from a high-minus-low portfolio which invests in currencies associated to high interest rate differential and shorts currencies associated to low interest rates differential (Lustig and Verdelhan, 2011).

2.$\mathbf{HML_{VAL}}$: the excess returns from a high-minus-low portfolio which invests in *undervalued* currencies and shorts *overvalued* currencies when currencies are sorted according to real exchange rate (Della Corte et al., *forthcoming*, Rafferty, 2011). The real exchange rate is computed as the ratio between S_t and PPP_t, where PPP_t is the purchasing power parity implied exchange rate[9].

3.$\mathbf{HML_{MOM}}$: the excess returns from a high-minus-low portfolio which invests in *winner* currencies that have experienced the highest returns during the previous quarter and, viceversa, shorts *loser* currencies that have experienced the lowest returns during the previous quarter.

We calculate the weights of the optimal portfolio as follows. Consider N assets/investment strategies with covariance matrix Σ. The global minimum volatility portfolio is the solution of

[8]For a comprehensive study about FX investment strategies which concerns also the adoption of technical rules see, among the others, Neely and Weller (2013).

[9]We use PPP data published annually every March by the OECD.

the following optimization problem: min $w'\Sigma w$ subject to the constraint $w'\iota = 1$, i.e. portfolio weights must sum to unity, where w is a $N \times 1$ vector of portfolio weights on the risky assets, ι is a $N \times 1$ vector of ones and Σ is the $N \times N$ covariance matrix of the asset returns. Given this setup, the global minimum volatility portfolio has weights such as: $w = \frac{\Sigma^{-1}}{\iota'\Sigma^{-1}\iota}$.

Interestingly, the optimal weight assigned to $HML_{\Delta U}$ is the highest and equal to 32 percent. When this strategy is included in the investment opportunity set, the global minimum volatility portfolio has a very high annualized Sharpe ratio equal to 0.79. When the $HML_{\Delta U}$ is not available to the currency investor, the Sharpe ratio of the global minimum variance portfolio is still high but drops to 0.64. In Figure 4 we plot the efficient frontier generated by the four investment strategies taken into consideration ($HML_{\Delta U}$, HML_{FX}, HML_{VAL} and HML_{MOM}), the global minimum volatility portfolio ($MV1$) when the investment opportunity set coincides with these assets and the global minimum volatility portfolio ($MV2$) when $HML_{\Delta U}$ is excluded.

3 Empirical Analysis: understanding portfolio returns

In this section we further investigate portfolio excess returns from sorting currencies according to past unemployment fluctuations. First, we briefly describe the standard asset pricing methodology that we employ. Second, we apply this methodology to our portfolio returns. In the last part of this section we investigate if portfolio risk-premia can be rationalized by other popular risk factors in the international finance literature, i.e. HML_{FX} (Carry Factor, Lustig and Verdelhan, 2011), HML_{VAL} (Value Factor, Della Corte et al., 2014) and HML_{MOM} (Momentum factor, Menkhoff et al. 2012).

3.1 Methodology

To investigate the source of the risk-premia generated by unemployment fluctuations, we rely on a stochastic discount factor (SDF) methodology (Cochrane, 2005) which is standard in the international finance literature (e.g. Burnside, 2011, Lustig et al., 2011, Menkhoff et al., 2012a). Differences in risk-premia (i.e. portfolio average excess returns) should be related to different exposures to a small number of risk factors.

We denominate the $n \times 1$ vector of portfolio excess returns as Z_t. By no-arbitrage risk-adjusted currency returns have zero cost and obey the following Euler equation:

$$E(Z_t m_t) = 0 \tag{1}$$

where m_t is a SDF in a linear form as $m_t = 1-(f_t-\mu_f)'b$ where b is a vector of SDF parameters, f_t is a vector of risk factors, and μ_f a vector including factor means.

By substituting the element of m in the Euler equation, this specification can be equivalently expressed in a beta representation of expected excess returns such as:

$$E(Z_t) = cov(Z_t, f_t)b = cov(Z_t, f_t)\Sigma_f^{-1}\Sigma_f b = \beta\lambda \tag{2}$$

where λ is a $k \times 1$ vector of factor prices of risk, β is a $n \times k$ matrix of risk quantities and Σ_f is the covariance matrix of f_t. λ and b are related each other as $\lambda = \Sigma_f b$ while the elements in β are the regression coefficients from a regression of portfolio excess returns on the risk factors. Hence, the SDF approach provides a methodology to estimate the risk prices λ which is alternative to Fama and MacBeth (1973).

We estimate the parameters of the Euler equation according to the Generalized Method of Moments (GMM) by Hansen (1982)[10]. In particular, we use a one-step procedure based on a set of three moment conditions. The first set of moment conditions are the sample counterpart of the Euler equation, while the additional two are required as factor means and the individual elements in the covariance matrix Σ_f need to be estimated. In this way, we incorporate estimation uncertainty (Cochrane 2005, Burnside 2011, Menkhoff et al., 2012a).

3.2 Pricing portfolio returns when $f_t = [RX \ HML_{\Delta U}]$

We start by investigating whether returns generated by unemployment fluctuations can be priced by RX and $HML_{\Delta U}$. This is done after a preliminar principal component analysis (PCA) applied to portfolio returns in the spirit of the work by Lustig and Verdelhan (2011). From the PCA, we find that the first principal component explains 80 percent of the common variation in returns and that there are no relevant differences across portfolios in the loadings. Hence, the first principal component can be interpreted as a level factor. Moreover, it has a correlation of 0.99 with RX. These are well-known results and the inclusion of RX in the specification of the SDF is now standard in the literature concerning cross-sectional asset pricing in currency market. Essentially, this factor captures the fluctuations of the US dollar versus other currencies. $HML_{\Delta U}$ is also an obvious candidate and can be interpreted as a

[10]We also estimate a traditional two-pass regression methodology as in Fama and MacBeth (1973). Here, the first pass is a time series regression of each portfolio j excess returns on the factors. The output of the first pass are portfolio factor betas. The second pass involves a cross-sectional regression of the portfolio average excess returns on the betas estimated on the first pass. The output of the second pass are the estimates of the risk prices λ.

slope factor. Indeed, we find that $HML_{\Delta U}$ exhibits a correlation of 0.80 with the second principal component. As in Lustig and Verdelhan (2011) we find that - among the six principal components - only the second one shows monotonic variation in portfolio loadings and, as a consequence, can be accountable for the variation in average returns. Importantly, beyond these statistical properties, the analysis of the previous sections has also suggested an economic, procyclical, interpretation of $HML_{\Delta U}$ as a risk-factor as the troughs are in correspondence of NBER recessions.

In Table 4 we show the factor betas estimated from time-series regressions of unemployment growth sorted portfolio excess returns on RX and $HML_{\Delta U}$. This corresponds to the first step in the two-pass Fama-MacBeth (1973) procedure. The estimated betas associated to RX confirm the interpretation of this factor as a level factor as common in the literature (e.g. Lustig and Verdelhan, 2011, Menkhoff et al., 2012a). On the other hand, the loadings on $HML_{\Delta U}$ show a monotonic pattern from portfolio one ($\beta_{HML_{\Delta U}}$ is -0.586) to portfolio six ($\beta_{HML_{\Delta U}}$ is 0.414). The different exposure to $HML_{\Delta U}$ at the portfolio level justifies the difference in the cross-section of portfolio returns. Portfolio one which includes bad unemployment fluctuation currencies yields the lowest returns on average but performs well in bad times when $HML_{\Delta U}$ declines, thereby providing hedging to investors. Viceversa, portfolio six which includes good unemployment fluctuation currencies yields the highest returns on average but performs badly in bad times, thereby adding risk to investors.

Table 5 presents estimates of the SDF parameters b joint with estimates of the risk price λ when the test asset in Z_t are excess returns of the unemployment fluctuation sorted currency portfolios and the risk factors in f are RX and $HML_{\Delta U}$. The object of our primary interest is λ, the price of risk associated to $HML_{\Delta U}$, which tells us if this factor is priced. This turns to be significant at the conventional level and equal to 3.65% on an annual basis[11](0.91% quarterly). This is the risk-premium of an asset with a beta equal to one. Given the beta-representation of expected excess returns, currency portfolios with higher beta should pay higher excess returns and this is consistent with actual portfolio returns (on average, the low unemployment growth portfolio pays higher return than high unemployment growth portfolio). The fit of the model is good with a R^2 equal to 75% and we cannot reject the null that pricing errors are equal to zero in a pricing error test. Figure 5 shows the returns predicted by the model versus the actual average returns of the unemployment growth sorted portfolios. Importantly, the model

[11]Importantly, the factor respects the no-arbitrage condition as the average of $HML_{\Delta U}$ equals the value of the respective λ on an annual basis. This holds true for RX as well.

does not systematically over or under-predict actual returns. The work by Lewellen, Nagel and Shanken (2010) points out the possibility that a strong factor structure in test asset returns can yield misleading results in empirical work. This happens when a risk-factor is correlated with the *true* factor. On the one hand, we cannot exclude that this is the case for $HML_{\Delta U}$ but, on the other, it is singular that - as we show in the next section - other risk factors are not priced in the cross-section of unemployment fluctuation currency portfolio returns.

3.3 Pricing unemployment fluctuations portfolios with other risk factors

In this section, we assess whether other risk-factors popular in the international finance literature are priced in the cross-section of our currency portfolios. This could provide further insights about the risk-premia generated by the portfolios. In particular, we take into consideration three risk factors: HML_{FX}, HML_{VAL} and HML_{MOM}. HML_{FX} is the risk-factor identified by Lustig and Verdelhan (2011) resembling a carry trade strategy that exploits UIP deviation. They find a high correlation between this factor and global equity risk. HML_{VAL} are the excess returns from a high-minus-low portfolio which invests in *undervalued* currencies and short *overvalued* currencies (Della Corte et al., *forthcoming*, Rafferty, 2011). HML_{MOM} are the excess returns from a high-minus-low portfolio which invests in *winner* currencies and, viceversa, shorts *loser* currencies. HML_{MOM} has been extensively investigated as a risk-factor in Menkhoff et al. (2012b).

$HML_{\Delta U}$ exhibits low correlation with these factors. Indeed, the correlation between $HML_{\Delta U}$, HML_{FX}, HML_{VAL} and HML_{MOM} is -0.11, 0.06 and 0.17, respectively. In Figure 6, we show the cumulative wealth from investing 1$ in 1990 Q1 and reinvesting the proceeds into these four currency investment strategies. As expected, HML_{FX} and HML_{VAL} offer the best performance at the end of the investment period. $HML_{\Delta U}$ comes afterwards, almost doubling the initial investment at the end of the investment horizon. HML_{MOM} is the worst performing. This is consistent with the findings reported by Menkhoff et al., (2012b) that the performance of currency momentum has weakened substantially over the last decade.

In Table 6 we show results of a simple time-series regression of $HML_{\Delta U}$ returns on the risk-factors HML_{FX}, HML_{VAL} and HML_{MOM}. Confirming the preliminary correlation analysis, we find no significant relationship between these risk-factors and our factor based on unemployment fluctuations. On the other hand, there is a statistically significant alpha (unexplained

part) relative to thees factors.

In the remaining we apply the standard asset pricing methodology employed in the previous section to check if these risk-factors are priced in the cross-section of our currency portfolio returns. More specifically, we try three different specifications of the SDF that differ just for the risk-factors included in f_t.

Table 7, Table 8 and Table 9 show the results when $f_t = [RX \;\; HML_{FX}]$, $f_t = [RX \;\; HML_{VAL}]$ and $f_t = [RX \;\; HML_{MOM}]$, respectively. No matter the estimation technique (GMM or FMB), the price of risk λ associated to either HML_{FX}, HML_{VAL} nd or HML_{MOM} is not significant at the conventional statistical level. This implies that these risk-factors are not priced in the cross-section of our currency portfolio returns and, hence, the cross-sectional differences in risk-premia are not related to them.

4 Further checks

In this section we perform two robustness checks. The first is a simple risk-factor versus characteristic test, while in the second we group currencies according to their beta with respect to $HML_{\Delta U}$.

4.1 Factor or characteristic?

A possible concern for our study is that the differences in the average portfolio returns are not related to exposure toward a specific risk-factor. Indeed, it is possible that these differences are related to the fact that by sorting currency according to the past growth in the unemployment rate we have discovered a new currency characteristic. Unfortunately, it is hard to exclude it with certainty, but we run a simple test to shed further light on this issue. In Table 10 we show the results of an asset pricing test in which the factors taken into consideration are RX, $HML_{\Delta U}$ and $\overline{\Delta U}$. The latter factor, i.e. the cross-sectional mean of the rate of growth of the unemployment rate shown in Figure 1, should take care of a possible characteristic effect related to unemployment. Despite the presence of $\overline{\Delta U}$, the price of risk associated to $HML_{\Delta U}$ is still statistical significant at the 10% level. While this is not enough to exclude the characteristic explanation, this finding is comforting for the interpretation of $HML_{\Delta U}$ as a risk-factor and for attributing the differences in average portfolio returns to exposure towards risk.

4.2 Beta-sorted portfolios

Finally, following a common methodology to investigate risk premia in financial markets (e.g. Pástor and Stambaugh, 2003, Lustig et al., 2011, Menkhoff et al., 2012a), we evaluate the performance of currency portfolios in which currencies are sorted according to their exposure to the risk-factor $HML_{\Delta U}$. If this factor is priced in the cross-section of currency returns, we would expect that, on average, currencies with higher exposure yield higher returns as they expose investors to the risk captured by $HML_{\Delta U}$ i.e. to incur in losses during NBER recessions.

Hence, we sort currencies into six portfolios according to their past beta with respect to $HML_{\Delta U}$. We estimate betas by using a rolling window of 3 years and rebalance portfolios every quarter. Results of this analysis are shown in Table 11. The evidence is mixed. Indeed, while we do not find the expected monotonic pattern in portfolio average returns mainly due to extremely high excess returns yield by portfolio three, we do find that the high beta portfolio six yields higher excess returns than the low beta portfolio one. In particular, the spread between these two extreme portfolios provides annual excess returns equal to 1.8% per annum with a Sharpe ratio equal to 18.6%.

5 Conclusions

In this paper, we empirically assess whether unemployment fluctuations generate predictability in the cross-section of currency excess returns. In order to do so, we allocate currencies of a large cross-section of OECD countries into portfolios according to the past rate of growth of the unemployment rate measured at the country level.

The analysis of the excess returns of the currency portfolios shows that, on average, currencies associated to past low growth of the unemployment rate offer higher returns than currencies associated to past high growth of the unemployment rate. Then, we investigate portfolio returns through principal component analysis and identify a slope factor accountable for the variation in average returns. We find that this slope factor is higlhy correlated with the investment strategy $HML_{\Delta U}$, which shorts currencies characterised by past high growth in the unemployment rate (i.e. *bad* unemployment fluctuations) to invest in currencies characterised by low growth in the unemployment rate (*good* unemployment fluctuations). The visual inspection of the this strategy shows that its performance deteriorates during NBER recessions. Hence, both statistical and economic considerations suggest that this strategy is eligible as a candidate risk-factor driving the difference in portfolio risk-premia. However, by exploiting a favorable

correlation structure with other popular currency investments, this strategy adds value for a currency investor by improving the Sharpe ratio of her optimal portfolio.

To get further insights about the risk-return trade-off of the unemployment fluctuation portfolios, we apply a standard asset pricing framework to gauge if popular FX risk-factors are priced in the cross-section of these currency portfolios. While we find that the risk-factor $HML_{\Delta U}$ is priced, this is not the case for HML_{FX} (Verdelhan, 2011, carry trade factor), HML_{VAL} (Menkhoff et al., 2015, Rafferty, 2011, value factor) and HML_{MOM} (Menkhoff et al., 2012b, momentum factor). As a consequence, the cross-sectional differences in risk-premia are not related to these risk-factors and further research is needed to shed light on the risk-return relationship of unemployment fluctuation currency portfolios.

References

[1] Akram, F., Rime, D., Sarno, L., 2008. Arbitrage in the Foreign Exchange Market: Turning on the microscope, Journal of International Economics, 76, 237-253.

[2] Bansal, R., Dahlquist, M., 2000. The Forward Premium Puzzle: Different Tales from Developed and Emerging Economies. Journal of International Economics, 51, 115-144

[3] Burnside, C., 2011. The Cross Section of Foreign Currency Risk Premia and Consumption Growth Risk: a comment. American Economic Review, 101, 7, 3456-3476.

[4] Campbell, John Y., 1999. Force of Habit: A Consumption-Based Explanation of Aggregate Stock Market Behaviour. Journal of Political Economy, 107, 2, 205-251.

[5] Cochrane, J., 2005. Asset Pricing. Princeton University Press, NJ.

[6] Constantinides, G., Duffie, D., 1996. Asset Pricing with Heterogenous Consumers. Journal of Political Economy, 104, 219-240.

[7] Della Corte, P., Ramadorai, T., Sarno, L., 2014. Currency premia and Global Imbalances, mimeo

[8] Della Corte, P., Ramadorai, T., Sarno, L., 2014. Volatility Risk Premia and Exchange Rate Predictability. Journal of Financial Economics, forthcoming.

[9] Engel, C., West, K., 2004. Exchange rates and fundamentals. NBER Working Paper No. 10723.

[10] Fama, E.F., 1984. Forward and spot exchange rates. Journal of Monetary Economics, 14, 3, 319-338.

[11] Faust, J., Rogers, J.H., Wang, S.Y.B., Wright, J., 2007. The high-frequency response of exchange rates and interest rates to macroeconomic announcements. Journal of Monetary Economics, 54, 4.

[12] Fischer, A., Ranaldo, A., 2011. Does FOMC News Increase Global FX trading?, Journal of Banking and Finance, 35, 11, 2965-2973.

[13] Hansen, L. P., 1982. Large sample properties of generalized method of moments estimators. Econometrica, 50, 4, 1029-1054.

[14] Hoffmann, M., Suter, R., 2013. Systematic consumption risk in currency returns. Working paper.

[15] Lewellen, J., Nagel, S., Shanken, J., 2010. A skeptical appraisal of asset pricing tests. Journal of Financial Economics 96, 175-194.

[16] Lustig, H., Verdelhan, A., 2007. The cross-section of foreign currency risk premia and consumption growth risk. American Economic Review, 97, 1, 89-117.

[17] Lustig, H. Roussanov, N., Verdelhan, A., 2011. Common Risk Factors in Currency Markets. Review of Financial Studies, 24, 3731-3777.

[18] Lustig, H. Roussanov, N., Verdelhan, A., 2014. Countercyclical Currency Riks Premia. Journal of Financial Economics, 111, 527-553.

[19] Meese, R.A., Rogoff, K,. 1983. Empirical Exchange Rate Models of the Seventies: Do they fit out of sample? Journal of International Economics, 14, 1-2, 3-24.

[20] Menkhoff, L., Sarno, L., Schmeling, M., Schrimpf, A., 2012a. Carry Trades and Global Foreign Exchange Volatility. Journal of Finance, 67, 681-718.

[21] Menkhoff, L., Sarno, L., Schmeling, M., Schrimpf, A., 2012b. Currency Momentum Strategies. Journal of Financial Economics, 106, 681-718.

[22] Menkhoff, L., Sarno, L., Schmeling, M., Schrimpf, A., 2015. Currency Value. Working paper.

[23] Neely, C.J., Weller, P.A., 2013. Lessons from the Evolution of Foreign Exchange Trading Strategies, Journal of Banking and Finance, 37, 10, 3783-3798.

[24] Newey, W.K., West, K.D., 1987. A Simple, Positive Semi-definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix. Econometrica, 55, 3, 703-08.

[25] Nucci, F., and Pozzolo A.F., 2010. The Exchange Rate, Employment and Hours: What firm-level data say. Journal of International Economics, 82, 2, 112-123.

[26] Pástor, L., and Stambaugh, R., 2003. Liquidity Risk and Expected Stock Returns. Journal of Political Economy, 111, 642-685.

[27] Rafferty, B., 2011. Currency Returns, Skewness and Crash. Working paper.

[28] Ranaldo, A., Soderlind, P., 2010. Safe Haven Currencies. Review of Finance, 14, 3, 385-407.

[29] Sarkar, A., Zhang, L., 2009. Time Varying Consumption Covariance and Dynamics of the Equity Premium: Evidence from the G7 countries. Journal of Empirical Finance, 16, 613-631.

[30] Sarkissian, S., 2003. Incomplete Consumption Risk Sharing and Currency Risk Premiums. Review of Financial Studies, 16, 3, 983-1005.

[31] Shanken, J., 1992. On the estimation of beta pricing models. Review of Financial Studies 5, 1-34.

[32] Verdelhan, A., 2010. A Habit-Based Explanation of the Exchange Rate Risk Premium. Journal of Finance, 65, 1, 123-146.

Tables:

Table 1: Rates of growth of the unemployment rate: descriptive statistics

The table presents descriptive statistics (mean, standard deviation, minimum and maximum value) of the annual rate of growth of the unemployment rates for each country in our sample. The time-span is 1990-2013 but there are countries with missing observations. For instance, for Austria annual rate of growth of the unemployment rate is available from Q1 1994 and, moreover, the exchange rate between Austrian schilling and US dollar is not available starting from Q1 1999 when Austria joined Euro. As a consequence, descriptive statistics for Austria refer to the period from Q1 1994 to Q4 1998.

	Mean	Std	Min	Max
AUSTRIA	3%	6%	-6%	15%
AUSTRALIA	0%	14%	-17%	48%
BELGIUM	3%	10%	-14%	24%
CANADA	0%	12%	-16%	39%
CHILE	-4%	14%	-24%	32%
CZECH R	6%	21%	-27%	70%
DENMARK	2%	20%	-23%	82%
ESTONIA	20%	65%	-28%	213%
EURO	1%	10%	-11%	28%
FINLAND	-12%	4%	-17%	-6%
FRANCE	3%	7%	-7%	14%
GERMANY	9%	8%	-4%	20%
GREECE	3%	7%	-7%	10%
HUNGARY	1%	12%	-22%	34%
ICELAND	11%	44%	-18%	183%
IRELAND	-6%	10%	-24%	13%
ISRAEL	-4%	15%	-21%	32%
ITALY	2%	6%	-9%	17%
JAPAN	3%	11%	-13%	36%
MEXICO	1%	18%	-33%	49%
NETHERLANDS	-2%	13%	-21%	18%
NEW ZEALAND	1%	16%	-27%	55%
NORWAY	-1%	14%	-35%	28%
POLAND	1%	18%	-32%	37%
PORTUGAL	3%	16%	-20%	39%
SLOVAKIA	-9%	8%	-22%	8%
SLOVENIA	-2%	7%	-13%	13%
S.KOREA	-1%	10%	-23%	23%
SWEDEN	10%	28%	-21%	93%
SWITZERLAND	14%	44%	-35%	150%
SPAIN	1%	11%	-11%	25%
UK	1%	12%	-16%	46%

Table 2: Unemployment growth sorted portfolios: excess returns

The table presents descriptive statistics (Mean, Standard Deviation (Std), Sharpe Ratio (SR), Skewness (Skew) and Kurtosis (Kurt)) for the excess returns a US investor obtains from investing in different currency portfolios. Mean, standard deviation and Sharpe ratio are annualized.

At the beginning of each quarter, currencies are sorted into six portfolios based on the associated country unemployment rate of growth over the previous four quarters. The first portfolio includes currencies of countries with the highest rates of growth in the unemployment rate while the sixth portfolio contains currencies of countries with the lowest rates of growth in the unemployment rate. The second last column presents the return a US investor obtains when borrowing in US dollars and investing in equal weights into all currencies, this return is labeled RX. The last column shows descriptive statistics for the unemployment fluctuation portfolio $HML_{\Delta U}$ which is given by a short position in portfolio one and a long position in portfolio six.

	P1	P2	P3	P4	P5	P6	RX	$HML_{\Delta U}$
Mean	0.018	0.014	0.019	0.036	0.033	0.055	0.029	0.037
Std	0.103	0.090	0.096	0.101	0.092	0.105	0.087	0.080
SR	0.176	0.157	0.197	0.356	0.355	0.529	0.336	0.465
Skew	-0.170	0.069	-0.021	-0.250	-0.115	0.066	-0.096	-0.461
Kurt	0.226	0.988	0.498	0.672	0.269	0.100	0.164	0.469

Table 3: Unemployment growth sorted portfolios: exchange rate returns

The table presents descriptive statistics (Mean, Standard Deviation (Std), Sharpe Ratio (SR), Skewness (Skew) and Kurtosis (Kurt)) for the exchange rate returns a US investor obtains from investing in different currency portfolios. Mean, standard deviation and Sharpe ratio are annualized.

At the beginning of each quarter, currencies are sorted into six portfolios based on the associated country unemployment rate of growth over the previous four quarters. The first portfolio includes currencies of countries with the highest rates of growth in the unemployment rate while the sixth portfolio contains currencies of countries with the lowest rates of growth in the unemployment rate. The second last column presents the average return a US investor obtains when borrowing in US dollars and investing in equal weights into all currencies, this return is labeled RX. The last column shows descriptive statistics for the unemployment fluctuation portfolio $HML_{\Delta U}$ which is given by a short position in portfolio one and a long position in portfolio six.

	P1	P2	P3	P4	P5	P6	RX	$HML_{\Delta U}$
Mean	-0.006	-0.001	0.004	0.021	0.012	0.035	0.011	0.042
Std	0.103	0.090	0.096	0.101	0.091	0.108	0.088	0.083
SR	-0.062	-0.013	0.041	0.211	0.128	0.329	0.123	0.506
Skew	-0.186	0.014	-0.156	-0.367	-0.138	-0.105	-0.228	-0.486
Kurt	0.842	1.056	0.996	0.910	0.273	0.214	0.372	0.575

Table 4: Unemployment growth sorted portfolios: time series regressions

The table presents estimates from time-series regressions of unemployment growth sorted portfolio excess returns on a constant (α), the dollar risk factor (RX), and the unemployment fluctuation risk factor ($HML_{\Delta U}$). Newey-West (1987) standard errors are reported in parentheses.

j	α	β_{RX}	$\beta_{HML_{\Delta U}}$	R^2
1	0.002	1.064	-0.586	0.93
	(0.001)	(0.037)	(0.046)	
2	-0.002	0.890	-0.115	0.74
	(0.002)	(0.097)	(0.067)	
3	-0.002	1.019	-0.050	0.84
	(0.002)	(0.043)	(0.048)	
4	0.000	1.043	0.195	0.85
	(0.002)	(0.057)	(0.057)	
5	0.000	0.920	0.142	0.79
	(0.002)	(0.061)	(0.052)	
6	0.002	1.064	0.414	0.93
	(0.001)	(0.037)	(0.046)	

Table 5: Unemployment growth sorted portfolios: asset pricing test with RX and $HML_{\Delta U}$

The table presents cross-sectional asset pricing results for the linear factor model based on the dollar risk factor (RX) and the unemployment fluctuation risk factor ($HML_{\Delta U}$). The test assets are excess returns to six carry unemployment growth sorted portfolios based on currencies from OECD countries. The estimated coefficients are the SDF parameters b and factor risk prices λ obtained by GMM and FMB cross-sectional regression. We use first-stage GMM and do not use a constant in the second-stage FMB regression. The reported GMM standard errors of coefficient estimates (s.e.) are calculated according to the VARHAC procedure. Lags are selected according to length of the sample, i.e. the number of lags included is equal to integer closer to $T^{0.25}$ where T is the number of the available observations. We also report the cross-sectional R^2 and the p-values of an asset pricing test in which the null-hypothesis is that all the pricing errors are not statistically different from zero. The reported FMB standard errors are based on the Shanken (1992) correction.

GMM^1	RX	$HML_{\Delta U}$	R^2	p_{value}
b	3.4654	5.3959	0.75	0.50
s.e.	2.5082	3.2088		
λ	0.0074	0.0091		
s.e.	0.0045	0.0043		
FMB	RX	$HML_{\Delta U}$	R^2	p_{value}
λ	0.0074	0.0091	0.75	0.55
s.e.	0.0045	0.0043		

Table 6: Time series regression: $HML_{\Delta U}$ vs other FX risk factors

This table shows estimates and standard errors obtained from running the following time series regression: $HML_{\Delta U} = \alpha + \beta.RX + \gamma.HML_{FX} + \delta.HML_{VAL} + \theta.HML_{MOM} + \epsilon$. The sample is 1990Q1-2013Q4. Standard errors are in parenthesis and computed according to the Newey and West (1987) methodology.

α	RX	HML_{FX}	HML_{VAL}	HML_{MOM}	$\bar{R}^2$
0.009	0.091	-0.083	0.115	0.110	0.01
(0.003)	(0.121)	(0.094)	(0.114)	(0.090)	

Table 7: Unemployment growth sorted portfolios: asset pricing test with RX and HML_{FX}

The table presents cross-sectional asset pricing results for the linear factor model based on the dollar risk factor (RX) and the carry trade risk factor (HML_{FX}). The test assets are excess returns to six carry unemployment growth sorted portfolios based on currencies from OECD countries. The estimated coefficients are the SDF parameters b and factor risk prices λ obtained by GMM and FMB cross-sectional regression. We use first-stage GMM and do not use a constant in the second-stage FMB regression. The reported GMM standard errors of coefficient estimates (s.e.) are calculated according to the VARHAC procedure. Lags are selected according to length of the sample, i.e. the number of lags included is equal to integer closer to $T^{0.25}$ where T is the number of the available observations. We also report the cross-sectional R^2 and the p-values of an asset pricing test in which the null-hypothesis is that all the pricing errors are not statistically different from zero. The reported FMB standard errors are based on the Shanken (1992) correction.

GMM^1	RX	HML_{FX}	R^2	$\chi^2_{p_{val}}$
b	6.6763	-24.8092	0.86	0.974
s.e.	6.0962	26.0296		
λ	0.0071	-0.0866		
s.e.	0.0044	0.0892		
FMB	DOL	HML_{FX}	R^2	$\chi^2_{p_{val}}$
λ	0.0071	-0.0866	0.86	0.950
s.e.	0.0045	0.0682		

Table 8: Unemployment growth sorted portfolios: asset pricing test with RX and HML_{VAL}

The table presents cross-sectional asset pricing results for the linear factor model based on the dollar risk factor (RX) and the value risk factor (HML_{VAL}). The test assets are excess returns to six carry unemployment growth sorted portfolios based on currencies from OECD countries. The estimated coefficients are the SDF parameters b and factor risk prices λ obtained by GMM and FMB cross-sectional regression. We use first-stage GMM and do not use a constant in the second-stage FMB regression. The reported GMM standard errors of coefficient estimates (s.e.) are calculated according to the VARHAC procedure. Lags are selected according to length of the sample, i.e. the number of lags included is equal to integer closer to $T^{0.25}$ where T is the number of the available observations. We also report the cross-sectional R^2 and the p-values of an asset pricing test in which the null-hypothesis is that all the pricing errors are not statistically different from zero. The reported FMB standard errors are based on the Shanken (1992) correction.

GMM^1	RX	HML_{VAL}	R^2	$\chi^2_{p_{val}}$
b	4.0314	7.7957	0.24	0.075
s.e.	2.7224	9.0477		
λ	0.0077	0.0115		
s.e.	0.0045	0.0127		
FMB	DOL	HML_{VAL}	R^2	$\chi^2_{p_{val}}$
λ	0.0077	0.0115	0.24	0.140
s.e.	0.0046	0.0126		

Table 9: Unemployment growth sorted portfolios: asset pricing test with RX and HML_{MOM}

The table presents cross-sectional asset pricing results for the linear factor model based on the dollar risk factor (RX) and the momentum risk factor (HML_{MOM}). The test assets are excess returns to six carry unemployment growth sorted portfolios based on currencies from OECD countries. The estimated coefficients are the SDF parameters b and factor risk prices λ obtained by GMM and FMB cross-sectional regression. We use first-stage GMM and do not use a constant in the second-stage FMB regression. The reported GMM standard errors of coefficient estimates (s.e.) are calculated according to the VARHAC procedure. Lags are selected according to length of the sample, i.e. the number of lags included is equal to integer closer to $T^{0.25}$ where T is the number of the available observations. We also report the cross-sectional R^2 and the p-values of an asset pricing test in which the null-hypothesis is that all the pricing errors are not statistically different from zero. The reported FMB standard errors are based on the Shanken (1992) correction.

GMM^1	RX	HML_{MOM}	R^2	$\chi^2_{p_{val}}$
b	3.4032	13.6863	0.82	0.840
s.e.	3.3219	8.4943		
λ	0.0065	0.0358*		
s.e.	0.0045	0.0200		
FMB	RX	HML_{MOM}	R^2	$\chi^2_{p_{val}}$
λ	0.0065	0.0358*	0.82	0.827
s.e.	0.0045	0.0181		

Table 10: Unemployment growth sorted portfolios: asset pricing test with RX, $HML_{\Delta U}$ and $\overline{\Delta U}$

The table presents cross-sectional asset pricing results for the linear factor model based on the dollar risk factor (RX), the unemployment fluctuation risk factor ($HML_{\Delta U}$) and the cross-sectional mean of the rate of growth of the unemployment rates ($\overline{\Delta} U$) shown in Figure 1. The test assets are excess returns to six carry unemployment growth sorted portfolios based on currencies from OECD countries. The estimated coefficients are the SDF parameters b and factor risk prices λ obtained by GMM and FMB cross-sectional regression. We use first-stage GMM and do not use a constant in the second-stage FMB regression. The reported GMM standard errors of coefficient estimates (s.e.) are calculated according to the VARHAC procedure. Lags are selected according to length of the sample, i.e. the number of lags included is equal to integer closer to $T^{0.25}$ where T is the number of the available observations. We also report the cross-sectional R^2 and the p-values of an asset pricing test in which the null-hypothesis is that all the pricing errors are not statistically different from zero.

GMM^1	RX	$HML_{\Delta U}$	$\overline{\Delta U}$	R^2	$\chi^2_{p_{val}}$
b	4.4071	7.0111	-7.1246	0.87	0.724
s.e.	5.6388	7.5848	12.1839		
λ	0.0073	0.0089	-0.1058		
s.e.	0.0058	0.0047	2.4493		

Table 11: Betas sorted portfolios: descriptive statistics

This table presents descriptive statistics (Mean, Standard Deviation (Std), Sharpe Ratio (SR), Skewness (Skew) and Kurtosis (Kurt)) for portfolios sorted on $HML_{\Delta U}$ betas, that is, currencies are sorted according to their beta in a rolling window time-series regression of individual currency excess returns on the unemployment fluctuation risk-factor $HML_{\Delta U}$. Portfolio 1 contains currencies with the lowest betas, whereas portfolio 6 contains currencies with the highest betas. The second last column presents the average return a US investor obtains when borrowing in US dollars and investing in equal weights into all currencies, this return is labeled RX. The last column shows descriptive statistics of the portfolio HML which is given by a short position in portfolio one and a long position in portfolio six. Mean, standard deviation and Sharpe ratio are annualized.

	P1	P2	P3	P4	P5	P6	RX	HML
Mean	0.009	0.026	0.041	0.018	0.017	0.027	0.023	0.018
Std	0.096	0.098	0.085	0.089	0.095	0.105	0.082	0.095
SR	0.095	0.264	0.489	0.207	0.176	0.253	0.282	0.186
Skew	0.004	-0.442	0.417	0.063	-0.155	0.066	0.126	0.001
Kurt	0.825	1.041	0.337	-0.189	0.559	1.749	0.514	0.624

Figures:

Figure 1: $\overline{\Delta U}$

The figure shows the cross-sectional mean of the rate of growth of the unemployment rate from 1990 Q1 to 2013 Q4. For each quarter t, this mean is calculated as: $\overline{\Delta U} = \sum_{c=1}^{N} \Delta U_{c,t}$, where N represents the total number of countries for which the rate of growth of the unmployment rate is available at quarter t. Shaded areas represent NBER recessions.

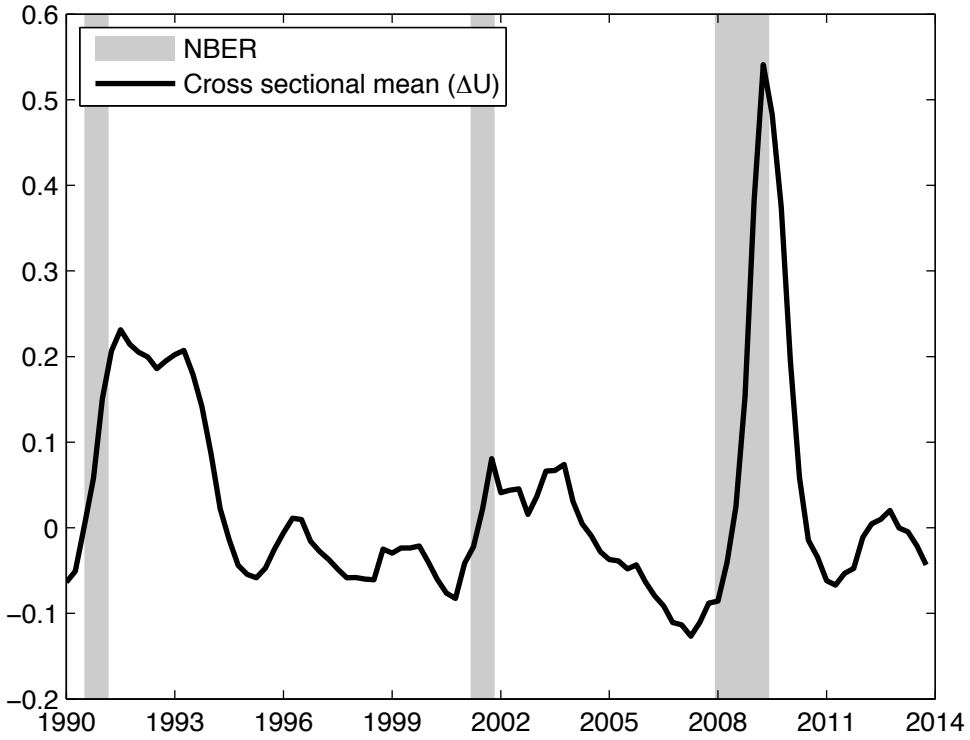

Figure 2: $HML_{\Delta U}$

The figure shows the returns from the investment that goes long in the low unemployment growth portfolio and short the high unemployment growth portfolio. This captures the unemployment fluctuation risk-factor $HML_{\Delta U}$. Shaded areas represent NBER recessions.

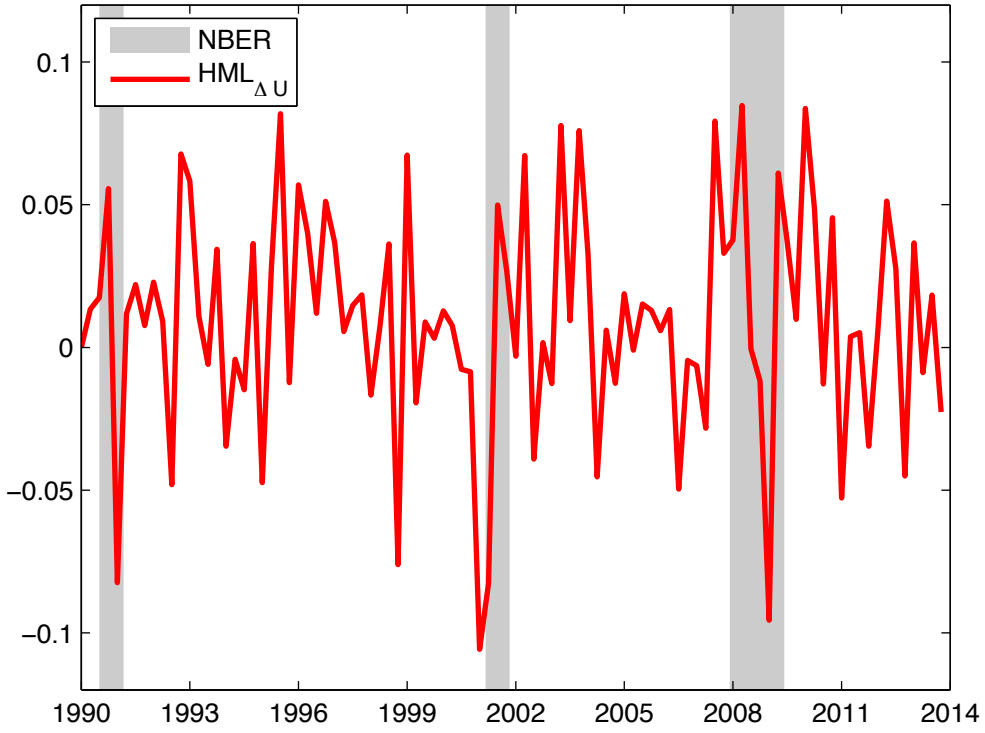

Figure 3: $HML_{\Delta U}$ **vs** HML_{FX}

The figure shows unemployment fluctuation factor $HML_{\Delta U}$ joint with the Lustig and Verdelhan (2011) HML_{FX} slope factor. Shaded areas represent NBER recessions.

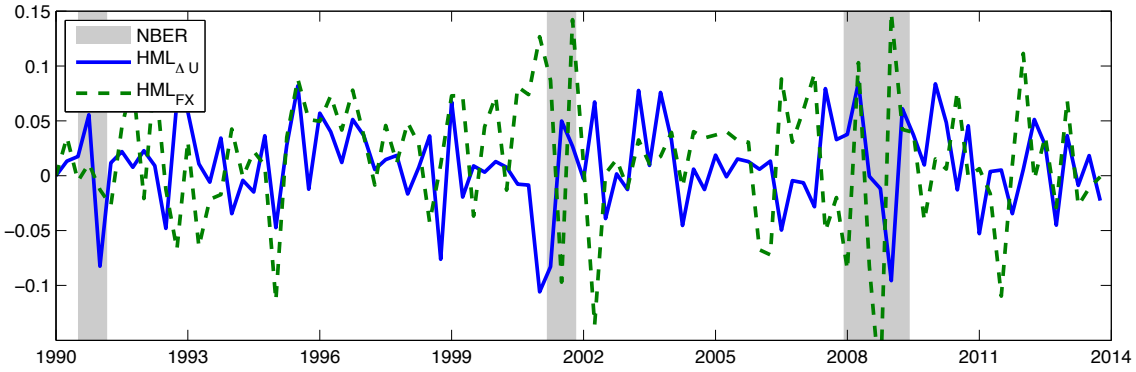

Figure 4: Global minimum volatility portfolios

The figure shows the efficient frontier (blu line) generated by the four investment strategies taken into consideration ($HML_{\Delta U} = UNE$, $HML_{FX} = CARRY$, HML_{VAL} and HML_{MOM}), the global minimum volatility portfolio ($MV1$) when the investment opportunity set coincides with these assets and the global minimum volatility portfolio ($MV2$) when $HML_{\Delta U}$ is excluded

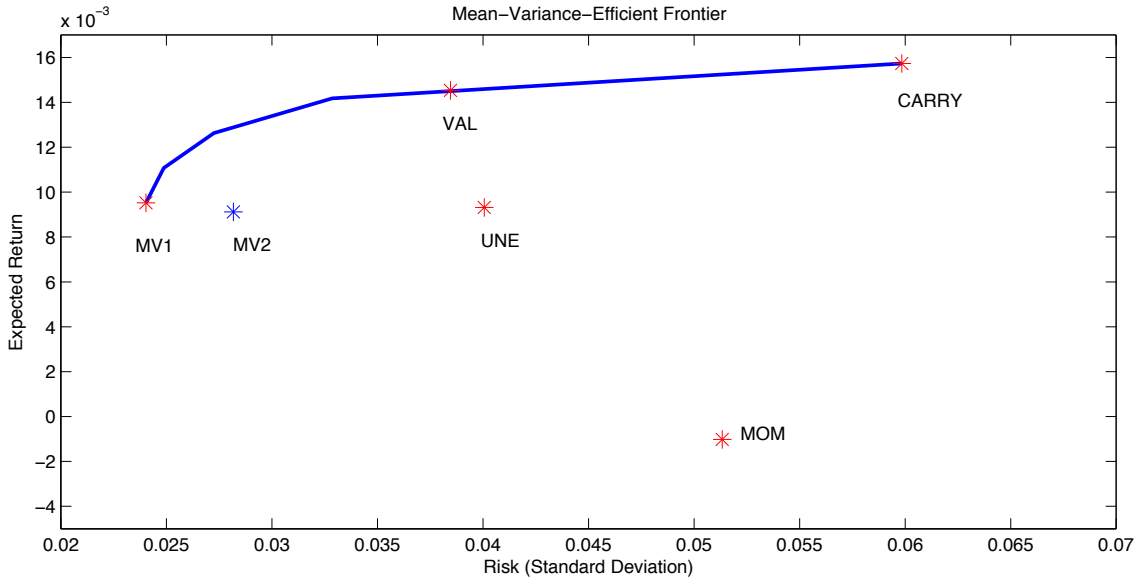

Figure 5: Actual vs fitted average portfolio returns

The figure shows actual average unemployment growth sorted currency portfolio returns (vertical axis) vs the returns predicted by the model (horizontal axis). Risk factors f in the SDF m are RX and $HML_{\Delta U}$.

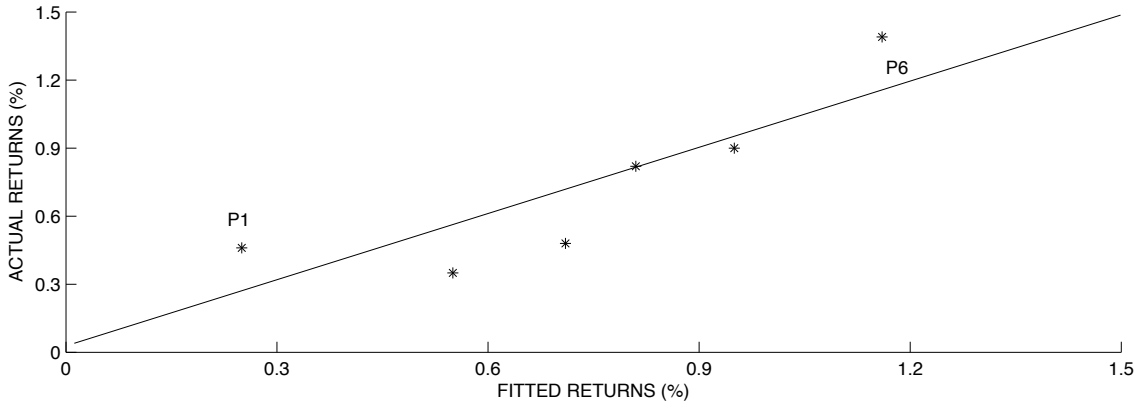

Figure 6: $HML_{\Delta U}$, HML_{FX}, HML_{VAL} and HML_{MOM}: cumulative wealth

The figure shows the cumulative wealth from investing 1$ in 1990 Q1 and reinvesting the proceeds for four currency investment strategies, i.e. $HML_{\Delta U}$, HML_{FX}, HML_{VAL} and HML_{MOM}. Shaded areas represent NBER recessions.