# Automated Trading in the Forex Market : A Trader's Guide to Success

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Designing and trading systems with understanding,

analysis and a focus on long term success

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# Contents

Remember, there are bold and old traders but there are no old bold traders...

# 1   Getting Started

## 1.1   Introduction

When I first started trading the forex market a few years ago I quickly came to the conclusion that manual trading was far too cumbersome. Trading by myself quickly slaved me to the screen of my computer making my stress level rise and my quality of life drop. Certainly, there had to be a solution to my problem. After searching on the Internet I found automated trading. That was the first time that the world of forex automated trading opened it's doors to me, I was amazed at what could be done and dreaming of what could be achieved. Little did I know that this journey through the world of expert advisors and automated trading would prove to be so challenging.

Today I can say that getting to where I am now took a big toll on both my pocket and my mind. I was once where you are now and I can tell you, I know the things that are going through your mind, I know all your doubts and your questions. You have probably already spent some or a lot of money on automated systems that don't deliver, on experts that have wiped your live accounts, you have probably wondered if this thing of "trading automatically" is really profitable. My objective with this ebook is to answer as many of these questions as I possibly can. I want to ensure that retail traders like you and me who are beginning their journey in automated trading as well as those who are more experienced but still have many questions can profit from the forex market by using automated trading techniques.

Within this ebook you will find a condensate of my experience using and evaluating forex automated trading systems. I will discuss with you what makes and what breaks automated trading systems, how you evaluate trading systems, the common flaws of commercial trading systems and many more topics that are of a paramount interest to anyone who really wants to profit from automated trading. Will it be easy ? No, it will not. Will it be impossible ? No, it will not. Moreover, my ebook will try to get you started with your first tested and reliable free automated trading system so that you can start experiencing the benefits that certainly can be achieved with automated trading systems.

It is my greatest hope that after reading my ebook on automated trading you will have a much clearer understanding of the whole world of expert advisors and that you will stop falling into the tricks and traps that commercial expert advisors

set for you (either with or without their intent). I am certain that even though reading my ebook will not make you a supreme expert on the subject it will serve as a solid starting point to start making real profits with automated trading systems.

## 1.2   Disclaimer

Even though all the results and discussions within this ebook are presented in good faith it is important to note that the contents do not constitute any type of investment advice. The contents of this ebook are the sole opinions of the author. The reader should understand this as well as the risks involved in trading the foreign exchange market which is one of the most volatile and leveraged. The author is NOT affiliated with any of the EA creators or EA programs mentioned through the ebook. The author does NOT receive a commission of ANY type neither to credit or discredit any of these experts. The evaluation of these programs is done within the criteria of the author.

## 1.3   What you <span style="color:red">should</span> be willing to do.

Before starting our journey into the world of automated trading systems it is very important for me to tell you the things you should be willing to do if you wish my ebook to be as useful to you as it possibly can. First of all, I would like you to forget everything you know about expert advisors and automated trading systems in general. Do not read my ebook with prejudice about things you may have read in forums, discussion groups, etc. People on those groups generally commit the same mistakes time after time and the amount of knowledge they can give you, even though sometimes useful, can also be very misleading.

Forget that automated trading is an easy thing to do. This one is the hardest because this may well be the reason why you decided to get into the whole expert advisor, forex thing. I can tell you that it is not an easy thing to do. I tell you this because I have had a very good amount of experience in this field and making profits from the market in an automated fashion is again, not an easy thing to do. You may be thinking that it is just a matter of finding a profitable system and letting run on your live accounts. It is SO much more than that ! Through my ebook you will discover that there are MANY things that can get into your ability to make profits EVEN if you do have a profitable trading system. Getting profits from automated trading systems is like any other job, it requires work and it requires a lot of knowledge. It is a matter of being realistic, I bet you have

heard 90% of retail traders lose their money in the forex market. Do you think that buying a set and forget system for 100 USD that another 10,000 traders are using will give you an edge ? I am sorry, as you may have suspected, it does NOT.

Be willing to do the WORK. Now that you have accepted that automated trading is NOT an easy task (I will explain this in great detail on the rest of the ebook) you now have to promise yourself that you will do the work that is necessary to become profitable in the world of automated trading. What does it involve ? The first step is to read this ebook and soak in all the information you can. The next step is to follow the advice I give through the ebook to help you become profitable. Will it involve learning to trade manually ? YES. Will it make you learn how to program ? Probably YES. Will it take you a lot of time and a lot of sweat ? YES. You may have guessed by now that in order to be a successful trader using automated trading systems you need an edge. My ebook will not give you this edge by itself but it will guide you in a path so that you may get it yourself. You know ? It is far easier to get somewhere when you have a map !

If you are not willing to follow the steps I outlined above, please stop reading this ebook now. If you thought you could make a living using automated trading by not doing anything I will have to disappoint you, you will not succeed. Trading with automated systems in the forex market is not something for anyone and this may not be a field you can succeed in. However I guess that if you bought my ebook, you are willing to make an effort an finally see the light at the end of the losing equity tunnel !

# 2   First Things First

## 2.1   What is an Expert Advisor ?

An expert advisor (EA) is a script written in the mql4 programming language destined to be used within the metatrader platform. The expert advisor is the code in which a trading system is programmed. An automated trading system is therefore the running of an expert advisor on a trading account. An EA works by executing a set of instructions on every tick that it is given. That is, the expert advisor is run every time a new tick is generated on a currency pair it is running on. The EA has specific instructions within it that tell it to open, close or modify positions as a function of any given mathematical operation of price or volume. When a new tick is generated the expert is run and it checks if it has to do anything according to it's logic. Long story short, expert advisors allow us to turn a trading system into a computer code that can be executed automatically, therefore, no human intervention is needed to run the orders.

## 2.2   Advantages of Expert Advisors

I guess you have read this a thousand times. Almost all commercial expert advisor sellers make great emphasis on the wonderful advantages of expert advisors. Given the fact that this ebook is about automated trading, I could not forget to mention the great advantages that these systems bring to a person's trading.

The main advantage of expert advisors is that they give you independence from your computer screens. An EA can execute your trading systems without any human intervention and therefore you can be sleeping or taking the sun at the beach while the expert advisor is doing all the trading for you.

The second advantage is the ability to operate 24/7 and therefore catch many market moves you would be unable to execute due to you being a biological being (you have to sleep, eat, have fun, etc). I would have to say that this is also a major advantage since the expert advisor is able to "watch" the market with far more efficiency and diligence than any human being.

The third big advantage is the ability to execute orders at an extremely rapid speed. If there is a 50 pip market movement in 2 minutes it is very unlikely that you will have the time to do as many things as a computer could. Given the ideal

trading environment, an EA is able to open, close or modify positions in split seconds making the execution of the trading strategy much more reliable than what it would for you.

An EA can watch an almost unlimited number of data streams. You of course, are unable to check 20 indicator variables on 10 currencies at the same time. Well, an expert advisor is capable of doing all these things for you.

As you can see, what it means to have an expert advisor is to have an extremely large number of possibilities. The fact of having a computer script execute our trading system allows us to explore trading techniques that were previously impossible to do with manual trading, it also gives us the possibility to use an unmentionable number of data streams and it makes trading independent from us, so to speak. A lot of people will also say that automated trading takes the "emotion" factor out of trading. They could not be more wrong ! (More on this later)

## 2.3   Disadvantages of Expert Advisors

Now we are going somewhere interesting ! Most commercial expert advisor sellers fail to give you the information about the disadvantages of automated trading systems. I will try to tell you now what the main disadvantages of using automated trading systems are. The understanding of each one of these problems is vital if you which to succeed in automated trading. Tackling these issues will make our chances of success with an EA much better.

The most important disadvantage of automated trading systems is that they are inflexible. An automated trading system cannot do anything outside of it's coding and is therefore limited to the logic you fix it to. The main problem with this is that the expert advisor may stop working profitably if market condition change against it, how far the expert advisor can adapt to changing market conditions depends mainly on the logic you give it but you always have to think that your expert is limited, it does not know anything outside it's logic.

The second greatest disadvantage is that people are deceived into thinking that there are no emotions in automated trading. This is a huge mistake and something that has made automated trading more difficult for the people who want to profit from it. Although the EA *perse* has no emotions, the trader that controls it's workings does have emotions. The nature of the emotions experienced during

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the use of an automated trading system are different than those experienced when trading manually but they can be as or even more destructive (more on this later).

They can be used as black boxes ! This is a great disadvantage of automated trading systems because it means that a person who has no idea of how a system actually works can load it on a trading platform and make it trade. What you get then is someone who does not understand what the system does or if it is profitable or not running a system on their computer. This of course is the area commercial expert advisor sellers exploit and an area you should be specially careful about. If there is something I have learned during my years of trading it is, do NOT trade any automated trading system you do NOT fully understand.

Expert advisor testing can be unreliable. This is a huge area of interest and something I have been asked several times by my web site's visitors and customers. A great problem arises when you combine the unreliability of some of the tests with the fact that black boxes can be sold. What you get is people buying systems that they think will perform great only to find out that their accounts get wiped out. (we will get much deeper into the testing of expert advisors later).

This sums up the main disadvantages and weak points of automated trading systems. Through the rest of this ebook you will get a lot more of information on these characteristics as well as how we can get around them to find and trade with profitable expert advisors.

## 2.4   The Psychology of automated trading

I decided to give the "emotions" part of automated trading a little explaining in order to better explain myself to people that may have been confused by my statements on the previous section. People usually associate automated trading with emotionless or purely logical trading and they are mostly right when talking about the expert advisors alone. Of course, in theory an expert advisor can be run on an account without any human intervention and therefore completely free of any emotion. However the reality is a little bit different.

As an example, when you run a metatrader expert advisor on your live account you are still subject to either winning or losing money on said account, therefore, you are still subject to the emotions of fear and greed that arise from losing or making money in the forex market. Lets assume you have a trading system that

has made you 50% profit on your account during the past three months. What would you do ? most people will continue to run this system as the system is making money. Well, if that was me, I would shut it down immediately ! That is because I know that a 50% profit demands a high market exposure and trading such a system at that risk level is simply greedy. The opposite also applies. What would you do if you have been trading a system for 6 months and it has produced a 2% constant draw down every month ? Do you continue running it or do you stop it ? Well, what do the tests tell you ? Do you expect this draw down ? Many profitable trading systems have extended periods of draw down before long trend catching moves (take the turtle system for example). As you can see, many people would just stop trading the ea out of fear.

Fear and greed, in automated trading and in manual trading are a mere consequence of IGNORANCE. If you know your trading systems and you know the market, you know what to expect and you also know when you are becoming either greedy with your profits or scared with your loses. This is why it is extremely hard for most people to trade profitable automated trading systems, because these systems generally trigger the fear part more and are therefore considered "hard to trade" because the trader needs to continue trading despite of several continued loses. On the other hand, unprofitable systems usually trigger the other side, something which makes them a lot more dangerous. Many commercial unprofitable systems usually generate a lot of short term wins which trigger the "greedy" side of the trader and make him or her continue to trade the system until it wipes them out. Now you can see why so many people lose in forex using automated trading systems ? It starts from here.

# 3   The Dangers of Automated Trading

## 3.1   Using Expert Advisors Without Knowledge

One of the most dangerous aspects of automated trading is when automated trading systems are used without a good knowledge of the market that their being traded on. Usually most people's approach to the development of automated trading systems is just throwing in a random strategy that they make up from a random array of market indicators. Most people don't even understand what these indicators even tell them. Even worse, few people even know how these indicators are calculated or what they were first developed for. For example, have you ever traded with the parabolic SAR or the MACD indicators ? Do you know what they mean ? Moreover, there is a strong tendency to try to use an EA on as many currency pairs as possible. This does not make sense ! An expert advisor should be developed and traded for a specific instrument given the fact that each currency pair has a given set of very specific characteristics.

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Market Myth : Many people believe that a single expert advisor should be able to trade on any given currency pair and produce profitable results because all currency pair movements are the result of human action. This is totally WRONG. Currency pairs are neither the same nor traded the same way, not because we are not all humans but because the composition of the trades of different currency pairs is different. For example, the EUR/USD has a high volume of speculation while the USD/CHF may have a higher volume of bank transfers. Remember that there are some transactions in the forex market which have nothing to do with speculation and just have to do with business (for example an exporter changing currencies because he made a deal) so currency pairs are affected differently at different times by different types and amounts of trades.

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You should then have in mind that trading an expert advisor successfully requires as much knowledge as it is needed for trading in a successful way manually. As I said earlier on the ebook, the road to success with an EA is not easy, even if the EA was already programmed you require this knowledge in order to know if the ea is really fit to trade the instrument you are going to use it on. How do you know if the system will work for you in the long term ? Only your knowledge of the given instrument coupled with the testing (which will be covered in a subsequent section) that has to be done are likely to shine any light into this problem.

## 3.2   Knowing How to Evaluate Experts

Probably one of the most complicated parts after having programmed or received an expert advisor is knowing how to really get an idea about the expert's profitability. This is why evaluating an expert advisor plays a vital role in determining the future potential of an expert advisor and the reason why it is a real danger in the world of forex automated trading. First of all, you must take into account that the way an expert advisor is evaluated can make it look more or less profitable depending on the choices made. There are mainly three types of tests that can be done on an expert advisor that we will cover in more detail later, these are backtesting, forward testing and live testing. None of this will truly tell you the long term profitability potential of an expert advisor. You can have systems that perform extremely well in back, forward and live testing for a period of one year, then wipe an account (I have seen it, it can happen). Yes, it can happen. Contrary to what most people believe, testing is NOT everything you need to know to say if a system is or is NOT profitable. Of course, testing has its extremely important uses which we will cover later when we talk in detail about the three types of testing and what each one of them can tell us about the trading system we are evaluating.

## 3.3   Knowing how to evaluate strategies

Your best barrier of protection against unprofitable trading systems that may perform with short term profits in tests is to use your knowledge about the market to evaluate the market strategies contained within the expert advisors. Of course, there are several types of strategies that we know for certain are NOT profitable and certain strategies which we know have been profitable for a long time and will most likely continue to do so. It is very important that you evaluate the trading strategy of any expert advisor before you start trading it in order to know if it does or if it does NOT fulfill the requirements for a long term profitable trading strategy. If an expert advisor does not fulfill this criteria then it is not worth even testing because even if the tests have short term profitable results, we know almost for certain that the system will fall short in the future. Section 5 will try to discuss with more depth which strategies we know are NOT profitable and which characteristics are shared amongst different profitable trading strategies.

# 4   Expert Advisor Profitability

## 4.1   What is a Profitable and What is an Unprofitable Expert Advisor ?

To start talking about profitable and unprofitable systems we must first define what we will call profitable and what we will call an unprofitable trading system. We will refer to profitable trading systems as long term profitable system, that is, a system that has been able to accumulate profit consistently from at least 2000 to 2009 in backtesting and that has shown from at least year long live or forward testing that the system's performance between back and live testing is consistent.

This means that long term profitable trading systems need to have reliable backtesting with live testing that confirms this fact. Long term profitable trading systems are very hard to find but are often the result of simple strategies that exploit market trends. An unprofitable system for us will be any system that fails to profit consistently for the market in the long term. Even if the system is able to show short term positive results an unprofitable system will lose this equity and probably wipe an account or break even in the future. Profitable and unprofitable trading systems can be distinguished according to their strategies, the way they manage their positions, risk to reward ratio, etc. All these variables are explained accordingly in Section 5.

If you look at the following graphs you will see the difference between a profitable and an unprofitable system (both graphs depict how a backtesting of ANY long term profitable system should look like globally). Long term profitable trading systems usually have equity curves that are overly linear in shape but have big wins and periods of loses along the way, unprofitable trading systems usually have straight line equity curves which then turn into sudden loses of equity as the expert advisor falls out of it's favorable market conditions.



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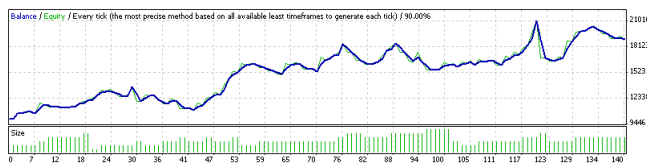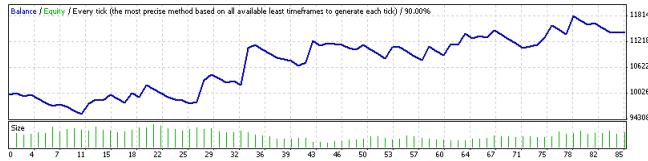
You should have already noticed by now that the distinction between a profitable and an unprofitable trading system is not so straightforward, a very careful examination of the trading system is required as said above, in order to tell an unprofitable trading system from a profitable one. To help regular traders examine a trading system and determine if it has the potential to be profitable in the long term I have prepared the following check list. Please make sure you read the whole ebook before using it on a trading system as the following sections will shed a lot of light into the different items mentioned below.

- Does the trading system use a higher timeframe ? (greater than or 60 min)

- Is the Risk to Reward ratio equal to or lower than 2 ?

- Are the SL, TP and TL calculated dynamically ?

- Is lot size calculated dynamically ?

- Is the system based in a trend following strategy ?

- Does the system have any type of filter for non trending periods ?

- Is the largest profit 4 times higher than the largest loss ?

- Is backtesting from 2000 to 2009 linear and profitable (like the graph showed above) ?

- Is there any live or forward testing that proves consistency with backtesting ?

Please note that a linear increase, does NOT mean that the system takes profit in a straight line but that global equity growth resembles a line, like on the graph shown below. A system that has an equity curve that looks like a straight line is NOT good, this usually means that the risk to reward ratio of the system is VERY HIGH or that losing positions are NEVER being closed.

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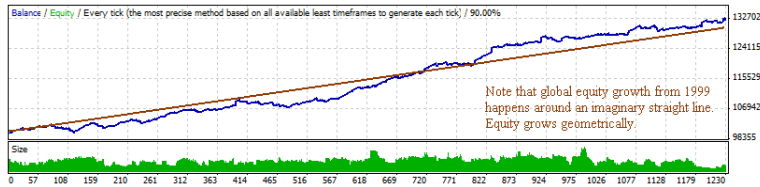
If you answered yes to all of the above questions, then your system is likely a long term profitable trading system. If you did not then you need to check if the strategy fulfills the criteria. If you answered no to most of the above questions then your system is probably NOT long term profitable and is probably just a short term profitable trading system. Please note that it is VITAL that the answer to the last two questions be YES for a system to be long term profitable. If the system cannot be backtested (because it uses several currencies, etc), you would need at least 3 years of forward testing to say anything about it's profitability. For that reason I usually limit my trading to systems that can be reliably backtested on a single currency.

## 4.2   Why most Expert Advisors Fail in the Real Market

One of the things you may have probably asked yourself many times is : Why are there so many commercial expert advisors out there with such excellent results that never seem to deliver in long term live testing ? Why do commercial expert advisor creators FAIL to have long live testing results if the expert is really profitable (and they have been selling it for so long) ? What is the reason why commercial expert advisors consistently fail in the real market ?

There are several reasons why commercial expert advisors fail to profit. First of all, the strategies used by most commercial EA sellers are not long term profitable strategies but are trading systems that generate short term instant profits. This has been a consequence of people wanting instant gratification instead of long term profits. As I said before in the ebook, the experts sold by commercial expert advisor sellers are most of the time designed to stimulate greed rather than fear. Since most people want to start their trading systems and see some profits right away, EA creators have shifted towards expert advisors that make some profit for a while and then fail dramatically due to their serious logical failures. A system that has a 10 to 1 risk to reward ratio will make profits almost right away but the system will inevitably lose all of it's profits once it hits a series of loses

(each one equivalent to 10 profitable trades).

By selling EA systems that profit for short periods of time these creators are able to show periods of profitable live testing and receive good reviews from customers who are happy with their purchases after one or two weeks. When the money back guarantee expires, the system starts to show it's real face and people start to see their accounts getting wiped out. I can see why people buy these systems, they want the huge profits they are promised with absolutely no work but they fail to accurately examine and judge the systems they are presented with.

If you apply the checklist shown on the previous section to all commercial expert advisors out there almost non of them will be able to answer 3 or 4 questions with a YES. The problem is that people who buy forex expert advisors are NOT professional traders and therefore do NOT know what is achievable and possible in the forex market. However, EA creators know what this people are "looking for" so they sell that to them. As long as people remain this ignorant about expert advisor systems it will be impossible for the majority of the EA selling market to shift this way.

The main problem with expert advisors made by commercial sellers and novice programmers in forums is that they fail to tackle two very important aspects of the market. They fail to recognize both market randomness and market exposure.

## 4.3   Market Randomness

Making money in the forex market is certainly not a hard thing to do. The hard thing to do is to make money and KEEP it. Many expert advisor strategies that fail to answer YES to the checklist questions on the previous section are usually based on market randomness. What I call market randomness is the unpredictable movement that price has on the lower time frames. Is it really random ? YES. On what timeframe ? This is pretty arbitrary but in my experience anything below the 60 minute timeframe starts to show serious signs of random movements. These movements are generated because the nature of the transactions that occur on such small time frames is completely random.

For example, in a 5 minute candle the transactions could have been due to international wire clearances while the next five minute bar could be speculative trading and so on. Have you ever wondered why trading strategies on the smaller

timeframes give profitable signals, then unprofitable signals inconsistently ? For example, if you trade a 8, 20 MA cross on a 5 minute timeframe you will see on the backtests that the signals are profitable for a while and then the signals turn unprofitable. This means that the system works for a while, then the reverse of the system starts to work. This is mainly because the underlying workings of the system are random and so are the results of the trades, therefore these strategies usually have a breakeven or losing character.

Another way to use market randomness is to have very high risk to reward ratios, as it is explained in much more detail later. Profitable trading systems do NOT rely on market randomness but in inherent characteristics of the market that are NOT dependent on the random transactions that happen on the lower timeframes. Profitable systems rely on the statistical direction of a large collection of transactions which is what we would call a trend.

## 4.4   Market Exposure

The market exposure of a trading system is defined as the amount of equity that is implicitly risked it order to achieve a certain level of consistent profitability. In order to reach a certain profit level you must be willing to risk a certain percentage of equity, just as the risk to reward ratio defines this within a particular trade so does the market exposure for the entire trading system. The forex market, in my experience, usually demands a market exposure of 1/4 to 1/2 of your yearly profit in a profitable trading system. That is, the maximum draw down or equity loss a system will have will most likely be around this number. When a trading system has a profit of say, 20% per month, this means that the system has a market exposure greater than 100% of the account, that said, you are just gambling your money in order to get those profits and the market will eventually demand it's toll.

This is the reason why you should be extremely careful with systems that claim profits that would put their market exposure above 100% of their equity, such trading systems are most likely showing you short term results which will then level when the market claims the exposure from the trader. As an example, if you go to a casino, your "market exposure" is always higher than 100% of your equity because the casino has a statistical advantage over you in any game. If you play 3 rounds of say, roulette, and win, that does NOT mean that you have a profitable system, it merely means that you were lucky. If you play for an indefinite amount of time you will wipe out all your money due to your "market

exposure". A similar thing happens in the forex market, the fact that a system made 20% for three months just means that it went lucky and has an over the top market exposure. Hopefully after reading this you will never fall again for this false and absurd claims !

## 4.5   How much money do profitable strategies make ?

This is a golden question for anyone who wants to trade the forex market profitably using automated trading systems. How much money does a profitable strategy make ? If you read the previous section carefully you will notice that the maximum profits we can make with a strategy are limited to the market exposure our strategy is able to achieve. In my experience with automated trading systems, I know that it is possible and realistic to make 40 to 60% a year relatively safely with profits in the order of 100% being achievable with aggressive money management.

These profits may sound really small to all of you out there who have been promised anywhere from 10 to 50% a month using commercial automated trading systems. Well, I can tell you that this is the real deal. Most of the traders I know make profits around these figures each year in the forex market and these profits are way above the 20% or so offered by the best hedge and mutual funds in the planet. If you want to risk making more 100% each year you are going into seriously dangerous territory as your market exposure will become too high. The people out there that are reading this after testing several commercial systems will most likely say I'm right.

## 4.6   How much Draw Down can I expect from a profitable strategy ?

As I said earlier in my section about market exposure, maximum draw downs are usually 1/5 to 1/2 of your yearly profits. In order to be safe I always consider the worst possible case which is a 1/2 of yearly profits draw down. Being pessimistic guarantees that you will do as much as you can to preserve your equity while having realistic and achievable profit expectations.

In the case above, for example, a trading system making 100% a year would mean a maximum draw down of 50%. Is this something you can tolerate ? If this

is something you are not able to tolerate then you need to tone down your risk settings until you reach a draw down level you feel sufficiently comfortable with. For example, you may settle for a 50% yearly profit with a 25% maximum draw down. Your draw down could probably be lower but you always need to consider the worst possible case in the event that it happens (and eventually it will).

This is just a small glimpse of the values that I know are achievable using automated trading systems, however you should determine the draw down and profit potentials of your profitable automated trading system by backtesting (after you confirm through live testing that the expert backtests similarly to how it trades in the real market).

# 5   Types of Strategies

## 5.1   Characteristics of Unprofitable Strategies

Amongst the different trading strategies that can be used in an automated trading system we know for certain that several strategies have smaller possibilities of working than others. Most certainly, I know that most unprofitable strategies share some characteristics that make them easy to identify and eliminate from your trading portfolio. If you find any strategy that has any of the characteristics outlined below, then it is very probable that this strategy will most likely NOT work in the long run. These strategies may generate juicy short term profits which make novice traders praise them as profitable and "holy grails" but these strategies all eventually wipe their accounts out.

### 5.1.1   The Risk to Reward Ratio

The risk to reward ratio of a trading strategy is defined as the amount of dollars risked for every dollar won. For example, if on one trade I risk 2 dollars to make 3 then my risk to reward ratio would be 2/3 or 0.66, this means that for every dollar I make I am risking only 0.66 dollars. Commercial expert advisor sellers quickly realized that having large risk to reward ratios guaranteed test results with better success. As you may see, it is much easier to reach a certain take profit value if your stop loss is further away (this is a consequence of the mean reversion theory).

> Market Reversion Theory : This theory states that price is bound to reach again a price
> level it has reached in the past in the near future. This means that if for example, the
> EUR/USD is at 1.3657 and then goes to 1.3660 it is bound to retouch the 1.3657 level.
> Because of this reason, the smaller a takeprofit and the larger the stop loss the easier the
> take profit will be reached

This is the reason why commercial system developers started to use huge risk to reward ratios. The main problem with using such high risk to reward ratios is that a lot of money is risked for a little so a single loss usually wipes out many winners. For example, on a 10 risk to reward ratio, it takes 10 wins to overcome a single lose. With this type of systems you will win most of the time (more than 90% of the time) but this will not be enough for your to be profitable. So you should NOT look at the winning percentage of an EA as a means to estimate

profitability because the amount of money made by an ea depends strongly on it's risk to reward ratio.

Now, speaking about these systems, it is obvious that the lower your risk to reward ratio is, the less likely you are to touch your take profit value (also a consequence of mean reversion) this means that you cannot base your profits on randomness but you need to find an inherent characteristic of the market you can exploit for your advantage.

> An inherent characteristic of the market is a market property that repeats itself in a cyclic fashion and can be exploited for profit. For example, it is known that the EUR/USD trends so exploiting this inherent characteristic of the market can give you a profitable system. The hard thing becomes to filter this inherent characteristic of the market from all the other "noise" experienced by the EUR/USD when it is NOT trending

This is of course a very good reason why profitable trading systems are much harder to find than commercial systems with high risk to reward ratios. Almost any strategy you can think of can be made profitable in the short term by increasing the risk to reward ratio while strategies that have risk to reward ratios lower than one and retain profits are extremely hard to come by. So when you are looking for a trading system, always look for risk to reward ratios lower than one, the lower the better. Systems with risk to reward ratios higher than 3 are very likely to be unprofitable in the long term so stay away from this type of strategies.

### 5.1.2   The Money Management

A very important aspect of every trading strategy that is usually neglected by most people that trade automated trading systems is the money management. I cannot tell you how many expert advisors I have seen that use a fixed lot size or a percentage of equity even though this two money management approaches are bound to make their strategy unprofitable or breakeven in the long term. Money management is extremely important and it CAN make the difference. What you should do with your money management is to try it to make you the same amount of money under any set of market conditions. The problem with a fixed Lot size or a lot size based in equity is that they ignore the market completely. I put it this way, would you buy the same amount of stocks if we where in a rally or in the middle of a market crisis ? Probably not ! The same thing happens in the forex

market, your lot sizing should adjust to the market in order to make your strategy more adaptable to changing market conditions.

Now, there are certainly ways that are not beneficial to money management (like fixed lot size or trading a percentage of equity) but there are money management schemes that are a definite no no and are SURE to eventually wipe your account out. Any strategy that increases lot sizes with loses is BOUND to cause this. For example, a strategy that doubles lot sizes after every loss (called a Martingale strategy) WILL wipe your account. No matter how many times someone comes out with a Martingale EA that they say won't wipe your account, it eventually WILL. A martingale strategy is a type of strategy that can show you year long back, forward and live testing results that are profitable and then wipe your account the next week. When you see a Martingale or a system that increases lot sizes in anyway, run ! These strategies will end up with your account being wiped out. If you have an ea with a fixed Lot size or account percentage based lot size, change it for a volatility adjusted lot size and you are bound to increase your system's reliability by a big percentage.

### 5.1.3   Fixed Orders

After years of testing many different testing systems and coming to learn the trading systems of successful traders I discovered something all of them had in common that all other unprofitable trading systems failed to have. All the long term profitable trading systems I have known up until now have dynamic Stop loss (SL), take profit (TP) or trailing stop (TL) values. This means that the systems do not assign a fixed pip size to these values but the values are dynamically assigned based on another criteria. This criteria can be volatility, a week low, a resistance level, etc. The few automated trading systems I know that have long term profitability use dynamic SL, TP and TL. The reason why this makes systems more profitable than using fixed values is the same reason as why dynamic lot sizing works better than fixed lot sizes. When you have your orders changing according to the market, your positions are adjusted so that you always get the most out of market moves. For example, (hypothetically) if the GBP/USD trended always around 150% of it's ATR value then you would constantly get out too early or too late when using a fixed TP, unless your TP matched the 150% ATR, on the contrary, if you had an ATR adjusted TP, the value would be reached every time and you would get a larger profit and a much better and reliable system.

> The ATR or Average True Range Indicator was developed by Welles Wilder and its
> concept as a money management adaptive tools was developed by the creators of the
> Turtle Trading system as a way to control position sizing and order placing. The Average
> true Range is a useful indicator to adjust your TP, SL or TL values against market volatility

## 5.2   Characteristics of Profitable Systems

As unprofitable trading systems have some characteristics in common profitable trading systems also have a set of characteristics that distinguish them. On this section I will attempt to illustrate which characteristics I have found common amongst the profitable trading systems I know. You may notice that several of these characteristics are very similar to the profitable characteristics of manual trading systems.

### 5.2.1   The Trend is your Friend

One of the first lessons new traders are taught is that one of the keys of manual trading is to be able to catch large trend moves. As well as with manual trading systems, reliable automated trading systems are often based in following the trend. If you want to develop or find a profitable trading systems a good way to start is to look for systems that follow trends. These systems usually take the form of either trend following or breakout systems depending on if they use just price action or price derived calculations (indicators) to start trades.

> Did you know ? There are only three different sources of information available when
> developing a trading system, those are price, volume and time. Use the three to your
> greatest advantage in order to develop a much more robust trading system.

### 5.2.2   Cut your loses, let your profits run

Another typical characteristic of profitable trading system and another very valuable lesson taught to new traders, you should cut your loses and let your profits run. This means that you should end trades that will not have a profitable outcome quickly while you should strive to keep your profitable trades alive for as long as possible. This is the base of all profitable trading systems I know including the

popular Turtle trading system. This also reinforces the hypothesis of not using fixed SL and TP and even more it further gives the idea of not having a TP at all and exiting either on an alternate exit criteria such as a price, indicator or TL based one.

For example some profitable trading systems use a TL as a dynamic exit criteria while others such as the turtle trading system or the 4 week breakout system use certain day length high or low breakout in order to exit trades. Both strategies can be profitable depending on the actual trading system. Other exits such as indicator based exits in the god's gift ATR system also prove to be incredibly beneficial when cutting loses short as the system can save itself from reaching the value of SL on many cases while keeping profitable trades alive to reach higher values.

### 5.2.3   Dynamic Volatility Adjusted Money Management

Another key aspect of profitable trading systems is having a money management system that can control the lot size traded in a way that it can adapt to the evolving market. Having a volatility adjusted money management system can help your trading strategy maintain it's profit through a large variety of different market conditions. This also ensures that profits during various volatility levels stay constant something which smooths out equity curves and guarantees a much more homogeneous return from the trading system. There can be profitable systems with no dynamic lot sizing but their profit potential increases or decreases as a function of market volatility.

### 5.2.4   The Risk to Reward Ratio

Since long term profitable trading systems are expected to take advantage of inherent market characteristics rather than market randomness it is usually expected for these systems to have a low risk to reward ratio. All the systems I have seen have risk to reward ratios of 3 or lower with the most profitable systems having risk to reward ratios of even 0.2 with 5 losing trades equaling one average profitable trade. These systems usually also have very large trend following profitable trades which make the largest profitable trade even 20 times larger than the average losing trade. Systems that trade with no TP and an SL usually benefit from this as the amount of capital you are willing to lose is fixed but the amount of capital you can win is unlimited.

# 6 Evaluating Trading Strategies

One of the most important aspects of automated trading is to correctly evaluate and optimize expert advisors. In order to do this, there are several types of tests that can be done. Each one of these tests gives us vital information about the trading systems and their characteristics. You should however know the limitations and characteristics of each one of these testing mechanisms in order to know what they can and most importantly what they CANNOT tell you. I will now try to go into each one of the different testing methods available for the evaluation of experts advisors trying to describe each one along with it's uses and limitations.

## 6.1 Backtesting

The first and one of the most important tests that has to be done on an expert advisor is a backtest. These tests are done with historical data and are a way to simulate how your expert advisor might have performed in the past. They also let you know if your expert advisor's logic is working the right way or if the code needs to be corrected in order to address trading problems. Backtesting however has several problems related to the way in which the simulations are carried out.

> Did you know ? Running high quality backtests is essential for accurate EA evaluation of trading systems that do NOT exploit the outlined backtester faults shown below. A video is available on the Asirikuy which explains to you exaclty how to achieve 90% modeling quality backtests on the metatrader 4 platform's strategy tester.

Since the metatrader platform does not store ANY tick data but only one minute candle data and volume data there is no way in which the expert can accurately know how the data within a one minute candle evolved (the strategy tester "guesses" how price moved from the one minute candle open to the one minute closing price). The metatrader 4 strategy tester does simple random data interpolations along the open and close of the candle trying to fill the whole volume assigned to that particular minute. What happens is that if you have a trade that was opened and has either its TP or its SL within a one minute candle then the result of the trade has no meaning because the nature of the ticks is not accurately simulated by the backtesting. This is the reason why MANY systems do NOT give reliable results when backtested. As a guide, backtesting results of systems with the following characteristics should NOT be taken into account :

- Systems with TP or SL values lower than 20 pips on major pairs and 50 pips on crosses or higher volatility pairs.

- Systems that are spread sensitive (because spreads are NOT changed by the backtester according to market volatility as a true broker would)

- Systems that target large volatility moves (because they usually enter the market on very long one minute bars which have a higher like hood of showing interpolation errors)

- Systems that enter trades within bars (systems that enter on last bar close or bar open are ideal since these values are known accurately)

- Systems that use future bar closes to trade (sometimes people do not program the code correctly and the expert advisors end up "looking into the future" by using the current bar's close before it actually happens)

As you may see now, many commercial trading systems are included in one of the above categories. This is the reason why sometimes their backtesting results show so much promise while their live or forward testing results fail to duplicate the results. Also bear in mind that when doing a backtest, the expert should ALWAYS be backtested and optimized during at least 8 years, and ideally for as long as the data allows. Make sure that your modeling quality STAYS at 90%, any lower is NOT acceptable.

Optimization of a given expert advisor should be done in order to maximize the profits as well as reduce the draw down caused by the trading system. The EA should first be optimized separately for each year, then the best backtesting results should be run over the whole testing period and the most profitable testing result should be used. It is very important NOT to optimize a trading system for a single year and work with that since you run the risk of curve fitting the expert advisor to current market conditions. Many people think that a system can be used an reoptimized every certain amount of time to keep it "tuned". The fact is that a trading system that has to be reoptimized is bound to be unprofitable since you are running optimizations for short periods in the past which rapidly change so you are running the risk of always being a step behind. Having optimized settings for at least 8 years guarantees that the ea is most likely to behave profitably even if market conditions change, since the ea evidently tackles an inherent characteristic of the market.

> Did you know ? ALL brokers use Metaquotes historical data to run 10 year backtests so running backtests on different brokers makes NO sense. However, backtests should only be run on FIVE digit brokers since the 4 digit broker data set is UNRELIABLE with 1 pip daily candles, Sunday candles, gaps in data, etc. If you want to have good backtests use the Alpari platform to run your backtests with the 5 digit data set. .

Finding a system that fulfills all the above characteristic and succeeds in the backtest is VERY DIFFICULT, it takes a lot of trading knowledge and skill to design a trading system that can in fact tackle an inherent characteristic of the market for such a long period of time. However, simple breakout trend following systems with simple filters have shown to be very good trading systems even though they are not popular (because they don't offer short term profits or trade ten times a day).

## 6.2   Forward and Live Testing

The next steps in the evaluation of an automated trading system is forward and live testing. Forward testing examines the performance of an EA on a demo account while live testing evaluates an expert under a live account on the real market. During my last two years of trading I have realized that the main objective of these tests is NOT to prove the expert advisor profitable. There are many systems out there that can give you even a year of live testing and then wipe your account in a day (Martingales and systems with 100:1 risk to reward ratios being an example). So what is the objective of doing live or forward testing ? The objective is to validate your backtesting. That's it. After you do live and forward testing you can make sure that your expert behaves in the real market as it does in backtesting. To do this you must backtest the period in which you have done a live test and verify if the results match. If they do, then you can say that the expert advisor is "consistent".

What does this mean ? Well, a lot ! It means that your whole backtesting is reliable so your system is truly long term profitable. You also know that your optimizations make sense because your backtesting is consistent so you can further develop your system with confidence. This testing also tells you that the system performs exactly as in backtesting so no programming glitches need to be corrected (sometimes there are some errors that happen in live testing that do not ap-

pear in backtesting). Always make sure you test your long term profitable systems for AT LEAST 2 years, this is enough to really ensure backtesting consistency and is what I would consider an "ideal" initial proof about the real profitability of a trading system. As a minimum to believe that an EA sold commercially is long term profitable we would need an 8-10 year period backtesting with a 1 year period of live testing that can validate the backtest, the live test should also have an investor password and login to confirm the veracity of the claims. ANY TRADING SYSTEM THAT DOES NOT HAVE THIS SHOULD NOT BE CONSIDERED PROVEN. A live test of at least 4 months that matches backtesting would be a BEAR MINIMUM to even consider testing the system.

As you can see, the information you can really obtain from testing is limited and you CANNOT substitute testing for thinking. Many people try to get a bunch of indicator signals together and test them with the hope that the system will be profitable in testing. The truth is that you should THINK FIRST program second. If your system has been developed with long term profitability in mind with a sound trading strategy, then testing is just he icing in the cake.

## 6.3   Comparing Live and Backtesting. Is the expert really profitable or NOT ?

If an expert advisor performs well in backtesting from 1999 and is then tested against live trading the backtesting of the live trading period should be done in order to compare the results of both trading periods. Often results will differ because the backtesting and the live testing data feeds are different. However, this still does not mean that results are NOT comparable. What you should look for is for both live testing and backtesting results to show the exact same trading patterns. That is, winning and losing periods should be of similar length and intensity with both tests reaching similar results. An example of this is shown below.
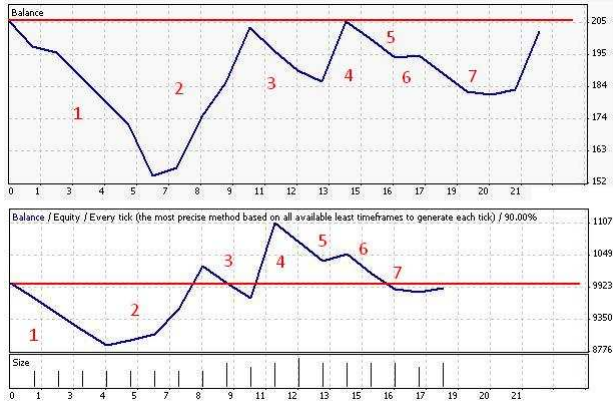
The above image shows a comparison between LIVE and backtesting results for the god's gift ATR expert advisor. You should notice how the expert advisor behaves globally the same around all the marked periods. For example, periods 1, 5 and 7 are losing while periods 2 and 4 are winning. Although the tests are not carbon copies because of the broker difference between metaquotes and fx-clearing, it is still clear that the god's gift ATR took similar trades in similar time periods. A closer look reveals that some trades are lost or won by a few differences in pips while others are not taken because the indicators did not reach the needed levels. However, this is a perfect example of what a trading comparison between backtesting and live testing is done.

Please see that the EA is long term profitable even though the results of the BACK and LIVE testing for this period of time IS NOT. The logic is pretty simple. The EA is profitable in backtesting from 1999. We know however that the EA has losing periods which can last for even several months. What we want to know is simply: Is the backtesting really accurate ? So if the live tests say it IS then we can suppose that the EA was profitable since 1999 and hence, we are talking about a long term profitable trading system. Short term profitability results mean NOTHING. Please say that out loud !

As a matter of fact, a comparison of a much longer period of back/live testing consistency from March 2008 to Decemeber 2009 reveals that the God's Gift ATR still maintains its live/back testing consistency (live and backtesting results are extrapolated to 100K to make them directly comparable). The image below shows you the comparison between live and backtesting for this period of time. You can see that live testing is even more profitable than the backtesting results obtained

for this EA. Please take into account that trades do not perfectly align since the charts are plotted as Trade Number Vs Balance and the trade number for both tests does not perfectly align since there are differences between the number of trades taken on both tests. However notice how globally the same equity highs are achiever as a function of time and the final equity achieved and the behavior amongst the different market periods is similar. This longer testing period does show the expert's long term profitability.
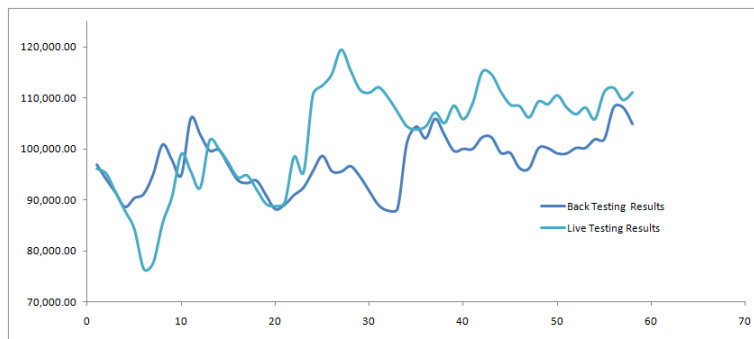


## 6.4   Choosing Brokers

Many people asked me to write a small section about forex brokers. Truth be told, your broker choice CAN affect your trading, being that automated or manual because brokers control the quality and nature of the feed you get. In general, forex brokers are highly unregulated and may pose a threat to your capital by themselves. Please make sure you stay within the realm of recognized international brokers. I have personally used brokers such as FXDD, IBFX, Alpari UK and fxclearing with very satisfactory results. Bear in mind that short term profitable strategies that are NOT profitable in the long term are HIGHLY susceptible to broker spreads and feeds because these parameters affect the randomness of the market while long term profitable systems are mostly unaffected by broker parameters.

When you trade a long term profitable system, you usually have stops wide enough to be almost impossible to hunt and systems that target large trend moves which cannot be in anyway filtered by the broker. Although your choice of broker CAN affect your profitability mainly because of the randomness between broker feeds a long term profitable system will still be such between different brokers, even if one broker is slightly more or less profitable than the other. The broker

sensitivity of a trading system is also a measure of it's quality, if your system is susceptible to spread and broker changes then it is much likely NOT a very robust or durable trading system.

# 7    A plan to be profitable in automated trading ! For the long term trader

## 7.1    The Learning Process

My first objective with this ebook is to educate traders both new and old so that they can really learn and take advantage of the great things offered by automated trading systems. In order for this to come out clearer I decided to work on a list of tasks that traders can use as a guide in order to become profitable in the world of forex automated trading. By following all the steps outlined below you will NOT ensure by 100% that you will be profitable in automated trading but I can assure you that this can be considered even a BARE MINIMUM to consider the possibility of long term profits in the world of computer controlled trading. I would advice you complete each item on the list in the order shown above although you are free to do things as you see fit.

- Trading, even automated trading is a job so you should treat it like it. Please do NOT expect to make money without working. You won't be glued to your screen but that does not mean there will not be any work.

- Learn to trade the forex market. That is right, you should learn to trade manually if you wish to succeed with automated trading systems. Learn how indicators are calculated, what they mean and what their intended use ACTUALLY is. Go to the original publications or books written by the original authors if it is necessary. We are NOT looking for "you should buy when the X line crosses bla" we are looking for "the X indicator was developed by Y, is calculated this way and will tell you this under these market conditions".

- Knowing how the market works is a necessity so you should definitely do this. How ? Open up a 100 USD account with a 10,000 USD contract size with the broker of your choice (these accounts with a smaller contract size are usually called "cent accounts" since you can trade from 1 cent per pip). You MUST NOT trade automated trading systems until you show a 1:2 maximum draw down to compounded yearly profit ratio . (Using demo accounts is NOT recommended as learning how trading affects your mind is a MUST)

- Learn about trend following systems that work. Learn about the turtle system, weekly breakout systems, etc. Get to know systems that can exploit trends (or any other proven inherent characteristic of the market and trade one of these systems manually)

- Learn how to code mql4 or hire a coder to write your program. Most coders will charge between 10 and 100 USD per hour, some will code for free. You need to find a coder who will now write your program or you can write it yourself. Make sure that you understand everything about the software !

## 7.2   What a System should Have. Designing your trading system.

After going through the steps outlined above (which should take you at least 2 or 3 years). You will be able to write your own trading system. When you are starting to write your own trading system you should take into account that your system must contain and define everything that needs to be within a strategy to make it profitable. A good place to start is to design your system around the checklist I talked about in an earlier section. Your system should ALWAYS define the following things in a literal explicit fashion.

- Entry Rules : Your system should define where and when the market needs to be entered. A definitive logic with NO room for interpretation must be established.

- Exit Rules : The system must clearly define WHEN the market needs to be exit. These exits must NOT be fixed and must always remain dynamic. The system should exit either via a dynamic SL or TL or via a closing mechanism that relies on an indicator. Even more, both systems can be combined to obtain the best of both worlds and greatly increase your expert's profitability.

- Money management : An adjustable dynamic money management that works as a function of the market AND a function of equity must be established. The turtle system offers a complete description of such a money management system and is a great place to start so that people can start making up their own money management strategies.

- Instruments : What will you be trading ? You should always ask yourself what exact currency pair will your trading strategy be destined for. That

currency pair should be studied so that the EA can exploit it as profitably and as much as possible

# 8   Start Your Profitable Trading

## 8.1   Limitations of Trading with another person's system

The following section will try to get you set and ready with a long term profitable automated trading system. However you should bear in mind that the use of an automated system that was NOT developed or programmed by you carries some serious limitations. First of all, it is VERY dangerous for your equity if you trade a system you DO NOT understand, please make sure you evaluate the logic of the god's gift ATR or any other third party expert advisor you plan to use before you actually test it. Make sure you understand the reasons why this expert works and can generate long term stable profits.

You have to be aware that running an automated trading system is NOT simply setting it up and forgetting it ! You must be conscious about the way the expert trades and how it will perform if you want to get the best results. The other risk you run with a long term profitable trading system is that you will most likely OVER or UNDER trade it if you are unaware of how the money management or risk parameters work. Please REPEAT any backtests yourself so that you can change the parameters and see the effects they have on the experts. All backtests should be done from 1999, not doing so curve fits the EA ! This is extremely important !

You should also understand that even though I have tested the god's gift ATR with high standards it is still impossible to ensure it will be profitable under ALL market conditions because there may be a set of conditions we have never seen that can render the software useless. This is something ALL expert advisors share (regardless of what the publicity of any commercial EA may say) but I have made sure through extensive testing that the god's gift ATR fulfills my checklist questions as well as the pertaining back and live testing criteria. The EA has also significant o features which make it flexible against market conditions changes. This is the reason why we have seen profitability in backtesting from 1999 to 2009 (which we can take for granted due to the coherence between back and live testing results).

## 8.2 The God's Gift ATR - A Long Term Profitable Trading System

### 8.2.1 The Experts Logic

The God's gift expert advisor follows a pretty complicated logic with 15 parameters determined for market entries and 10 parameters designated for the closing of orders. Mainly, the expert advisor reacts to three different types of indicators. The first are volatility indicators in the form of Bollinger Bands and the Keltner Channel indicators, the second are oscillators in the form of several different stochastics and the Wadahh Attar Explosion indicators and the third are lagging indicators in the form of exponential moving averages. What we are looking for with this expert is to enter the market when we are at the start of a new market cycle. For this we want long and medium term stochastics to be at the opposite extreme of the short term stochastic. We also want price to be inside the Bollinger bands and keltner channels and we also want price to be below or above the slow ema. The expert's logic may not sound too familiar to most new traders at first but a careful study of the rules and the indicators shows why this expert advisor is geared towards long term profitability. We aim for the start of big market moves.

As many of my customers and website readers have asked me I have decided to extend the explanation of both the logic, variables and criteria in order to make it far more understandable. The god's gift expert advisor aims at entering trades when the market retraces from a trend. The main idea is that the short term stochastics should show an inverted direction while the long term trends should show the right direction of the trend. This is the way in which the expert advisor determines that it is within a retracement of a larger market movement. The fact that price must remain within the Bollinger band and Keltner Channel indicators just ensures that the movements are true retracements. If the market movement is outside the volatility indicators then the movement is most likely a price spike and not a true market retracement. This entering of positions within a retracement ensures that the god's gift catches large market moves.

I will now try to explain the system's logic and variables so that traders who want to trade this great system will have a better idea of what the system is doing and what they can an cannot expect from it's logic.

### 8.2.2   Entering Trades

In order for the expert to actually enter a trade, we need 12 fixed rules to be met and one of 3 optional rules to be met. The fixed rules include the positioning of the volatility indicators and the stochastics and slow ema while the optional rules are related to the positioning of the volatility indicators (relative to each other) the positioning of the fast ema and bar's high or low relative to the Bollinger bands indicator. The following is a small summary of the system's rules.

### 8.2.3   Fixed Rules

In order to enter a Long trade all of these rules have to be met (reverse for short trade):

1. Long term stochastic must be above StochBuy variable Value
2. Medium term stochastic must be above StochBuy variable Value
3. Difference between current Medium Stochastic and Last Bar's value must be greater than 5
4. Difference between Medium Stochastic and Long term stochastic should be no more than MaxStochDifference variable
5. The moving average with period equal to the ema_period variable should have a higher value than in the previous bar
6. Price should be below the Upper Bollinger Band (above lower for short)
7. Price should be below the Upper Keltner Channel Band (above lower for short)
8. Short term stochastic should have a value smaller than the ShortStochBuyEntry variable
9. Current long term stochastic plus seven should be greater than previous bar's long term stochastic
10. Current medium term stochastic plus ten should be greater than previous bar's medium term stochastic
11. Current bar's high should be below the upper bollinger band

### 8.2.4   Optional Rules

In order to enter a Long trades at least one of these has to be met (reverse for short trade) :

1. Keltner Channel's B lower band must be above upper Bollinger band

2. 9 Period Exponential Moving Average must be above current bar's low (below current bar's high for short)

3. Current Medium term stochastic is greater than previous bar's medium term stochastic

### 8.2.5   Exiting Trades

In order to exit a trade we have several options. The position can be closed by the order reaching it's designated stop loss or take profit value or the order can be closed by any of the following internal logics (conditions given for longs, reverse for shorts) :

1.Current Waddah_Attar_Explosion indicator line must be below the indicator's current histogram value (this conditions must always be true in order to exit a position)

2. Keltner Channels B lower band must be above lower Bollinger Band

3. Current bar Long Term Stochastic must be below 80 ( above 20 for short )

4. Current bar Medium Term Stochastic must be below 50

5. Current short term stochastic is above the ShortStochBuyExit variable

6. Price must be above the upper Bollinger Band

7. Difference between the current value of the Medium Term Stochastic and the last bar's value is larger than the Risk Factor Variable

8. Difference between current value of the Medium Term Stochastic and the value 2 bars ago is larger than TwoPeriodExitMultiple*RiskFactor/10 (variables).

### 8.2.6   Expert Advisor Variables

Now I will try to describe what each variable of the expert advisor does so that you can modify them and understand what consequences they may be having on the experts behavior :

MagicNumber = 0 - distinguishes this expert from others trading the account, set to any number

initial_balance = initial balance of the account. It should be set to the initial value of the account and it should not be changes.

enable_ecn = enable ECN compatibility

RiskFactor = 26 - Affects the closing of positions, setting to a higher number lets positions run for longer, generally increasing draw downs and profits

SignalMail = False - sends signals to your email

EachTickMode = True - Uses current prices, setting to false sets all indicators to shift one bar in the past

Risk=1 - ATR Risk, multiplies traded lot values by the specified value, only relevant if Lots_ATR is set to true

Lots_ATR = False, calculates lot sizes using the ATR indicator and the Account Balance (adjusts traded lot size to volatility)

Lots = 0.1 - Sets the amount of lots traded (irrelevant if Lots_ATR is set to true)

Slippage = 2 - value of accepted slippage

Orders_ATR = False - Calculates orders as a percentage of the average true range

Percentage_ATR_SL = 50 - Only relevant if Orders_ATR is set to true, it calculates the stop loss as the given percentage of the average true range

Percentage_ATR_TP = 50 - Only relevant if Orders_ATR is set to true, it calculates the take profit as the given percentage of the average true range extern double

Percentage_ATR_TL = 50 - Only relevant if Orders_ATR is set to true, it calculates the trailing stop as the given percentage of the average true range extern

StopLossMode = True; - If set to false the ea will not use a stoploss

StopLoss = 70; - Fixed value in pips, only relevant if Orders_ATR is set to false

TakeProfitMode = True;- If set to false the ea will not use a take profit

TakeProfit = 150; - Fixed value in pips, only relevant if Orders_ATR is set to false

TrailingStopMode = True; - If set to false the ea will not use a trailing stop

TrailingStop = 30; - Fixed value in pips, only relevant if Orders_ATR is set to false

UseHourTrade = True; - Set to true if you want to restrict trading between certain hours

FromHourTrade = 10; - Only relevant if UseHoursTrade is set to true, controls the beginning of the trading period

ToHourTrade = 10; - Only relevant if UseHoursTrade is set to true, controls the end of the trading period

RequiredStochLevelSell = True; - Sets the entry conditions 1 and 2 on or off

StochSell = 40; - Used in entry conditions 1 and 2

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RequiredStochLevelBuy = True; - Sets the entry conditions 1 and 2 on or off
StochBuy = 60; - Used in entry conditions 1 and 2
stochShort = 1; - short term stochastic %K period
stochMed = 20; - medium term stochastic %K period
stochLong = 50; - long term stochastic %K period
ShortStochSellEntry = 80; - used in entry condition 8
ShortStochBuyEntry = 20; - used in entry condition 8
ShortStochSellExit = 10; - used in exit condition 5
ShortStochBuyExit = 90; - used in exit condition 5
MaxStochDiffMedvsLong = True; - controls the use of entry condition 4
MaxStochDifference = 8; - value used in entry condition 4
TwoPeriodExitMultiple = 16; - controls exit condition 8
EMAPeriod = 40; - determines the period of the exponential moving average
using in the entry condition 5

### 8.2.7   What Parameters to use ?

The backtests provided with the expert advisor contain the parameters I have
found to be profitable on several currency pairs for the past 10 years of back-
testing. The parameters used in the backtest for the GBP/USD and EUR/USD are
the ones which are currently being employed in live testing. However you can test
with different combinations of parameters to optimize the method. When you do
this you should bear in mind that optimizations should be done during the past 10
years in order to obtain linear equity curves as the ones shown on the backtests.
Notice how the ea manages to get very large winning trades and quickly gets out
of the market when trades are not bound to work out. Since we have a very large
variety of exit conditions we quickly get out of any market setup that does not fa-
vor the expert's trading. This complexity does not make the ea less robust as you
can see that it performs almost exactly the same for a very long period of time.
As you can see on the forward testing statement of the regular god's gift ea which
was tested for the whole year of 2008, the ea showed the same profitability as in
backtesting, which means it is a fairly consistent expert advisor.

### 8.2.8   Trading the Expert Advisor

The ea should be traded and backtested on the one hour charts. If you wish to
conduct trading on live accounts please do not test on account with less than

1000 USD of equity without the Risk variable setting higher than 5. This settings should, as per the already obtained results, give us a profit of around 50% a year with a draw down never exceeding 30%. Bear in mind that this expert can have many several consecutive loses (as many as 25) and then one very big profitable trade. You should wait for at least 6 months of forward testing to actually see a good spectrum of results from the expert. As you can see on the tests, there are periods in which the expert makes 20-30% profits followed by flat or slightly losing periods which end up with another large profitable trade. The logic followed by this expert advisor has shown to be reliable and I can say I trust it and use it on my personal live accounts. However, you should as always understand that this does not constitute any investment advice and that past performance is at the most an indicative but not a guarantee of future results.

## 8.3   Frequently Asked Questions about the God's Gift ATR

I compiled a list of the questions I have been asked most frequently by customers regarding the god's gift ATR EA and the way it should be tested and traded.

Q : The god's gift ATR produces only X% a year. Isn't that too low for the forex market ?

A : Well, it is too low if you consider what the hyped commercial packages are offering. That is because commercial expert advisors do not offer you real results because most of these systems are NOT long term profitable. If you see the few that are likely long term profitable you will notice that the market exposure and profits are similar to the god's gift EA.

Q : What is the difference between the Risk and the Risk Factor setting ?

A : The risk factor variable controls entry parameters and should be left at 26 while the Risk variable controls the multiplication of the ATR lot calculation. Changing the risk value changes the amount of money risked. You should do backtesting to see what draw down you are comfortable with. Risk variable should NOT be set higher than 5 for the first 6 months of live trading.

Q : What are all these alerts ? is this a manual or semi-automated trading system ?

A : The alerts are generated by the indicators and in no way represent the expert's logic. You should completely ignore these alerts, do not execute any trades as these alerts do NOT consitute trading signals of the EA and are NOT in anyway related to the trading logic, they are just alerts generated independently by the indicators used by the EA. The EA is a totally automated system and will execute and manage trades when the market meets its entry logic.

Q : Can the god's gift ATR EA be traded with other experts ?

A: Yes, just make sure you set the magic number of the EA to a unique integer different to that of other systems.

Q : Can the god's gift ATR EA be traded on several pairs ?

A : Yes, the god's gift ATR has been optimized to trade the EUR/USD, the USD/JPY and the GBP/USD. However, each one of these currencies must be tested on a SEPARATE account and each one has to be traded with it's OWN OPTIMIZED SETTINGS. These settings are provided as set files with the forex automated trading ebook support materials.

Q : How long will it take to see results ?

A : The god's gift EA can have draw down periods that can last for as long as 6 months so always trade the EA for at least 2 years before you decide anything. Please remember that the forex market is NOT your 9 to 5 job. You do not get paid every month and sometimes it may take a while to reap your rewards. This is a characteristic of several profitable trading systems and something that experienced traders have known for more than 20 years.

Q : Do I need a VPS to trade the god's gift ATR EA ?

A : YES ! A VPS or virtual private server is ALWAYS needed if you want to trade the god's gift ATR EA in a reproducible, profitable and safe way.

Q : Does the EA comply with new NFA regulations ?

A : The EA actually does comply with NFA regulations and ECN brokers.

Q : Has all the work been done for me ? Do I set and forget the God's gift ?

A : You should know by now that the answer to these questions is NO. The god's gift ATR was developed with all the long term profitable concepts in mind but it is apt to you to be able to grasp these concepts and trade the EA correctly. Probably most of the people trading this EA will desist after the first 4 month draw down because they failed to understand how the system worked. Please remember that fear and greed play a VITAL part in automated trading and that the understanding of both the code and the inner working of the expert advisor are the only thing that can save you from undermining or overestimating the profitability of the god's gift ATR.

Q : What Tests have been done with the god's gift EA ?

A :

- Backtesting of the god's gift 7c from 1999 to 2007

- One year forward testing of the god's gift 7c from 2007 to 2008

- Backtesting of the god's gift ATR from 1999 to 2009

- Optimization of parameters in backtesting for the EUR/USD, GBP/USD and USD/JPY

- Live testing on accounts owned by myself on the EUR/USD, GBP/USD and USD/JPY (from 01 March 2009)

- Independent live tests currently being carried on the USD/JPY and GBP/USD

Q : What broker should I use ?

A : Up until now the EA has been tested on FXDD, fxclearing and fxlite. I would advice you choose a non US broker because of the absence of the new NFA regulations regarding pending orders. The EA is fairly broker independent and should show you similar results regardless of your broker. Please choose a broker you feel comfortable with. The EA is unlikely to be much affected by broker feeds and spreads because it's main targets are long trend moves which do

NOT change. The stoploss of the EA is also big enough to avoid any potential stop hunting made by the broker.

Q : The EA has been on the chart for a few days but there are not trades yet. Is this ok ?

A : Since the god's gift ATR EA aims for high probability trades it does not enter the market very often. This EA usually trades 2 or 3 times per week and sometimes it does not trade even for one or two weeks depending on the overall market conditions. Do NOT expect this EA to trade everyday or several times a day. Only expect an average of 4 to 8 trades per month. However you should check the Journal tab of your metatrader terminal to see if there are any errors being generated by the EA. Errors can arise if you choose the wrong digit number (set five_digit_broker to true if you have a five digit broker), if you choose the wrong account type (setting mini_account to true if you don't have a 10,000 USD contract size WILL cause problems) or if you fail to have adequate funding on your account (you need at least 1000 USD to trade this EA with 100 USD with a 10,000 USD contract size being the BARE minimum).

Q : Do the indicators need to be on the charts ? Do I need to copy the indicators ? how do I install the expert advisor ?

A :The indicators do NOT need to be loaded on the charts since they are AU-TOMATICALLY loaded by the EA once it starts to run. They do however need to be copied to the /experts/indicators directory and compiled (just restart mt4) in order for the EA to find them. You can also find a wealth of videos on youtube and other websites about how to accurately install an expert advisor.

Q : Can the EA be traded on a different time frame ?

A : Maybe it can be done but I have NEVER tested the EA on a different timeframe other than the one hour. It is therefore EXTREMELY recommended to stay within this timeframe. Separate live and backtesting would be necessary if you expect to trade the EA profitably on another timeframe. Personally I have NOT found any set of results that are profitable from 1999 using anything but the one hour chart.

## 8.4   Trading Examples

The objective of this subsection is to show you some of the trades which have been taken live by the god's gift ATR expert advisor. You will notice that most of the time the expert advisor loses trades it does so in a small to medium fashion while winning trades usually can take in much larger amounts of equity. The following live trades where taken from 4 live account trading the GBP/USD, EUR/USD (two accounts with two different set files) and the USD/JPY. You will notice that the on EUR/USD set file and the USD/JPY have ShortStochSellExit and Short-StochBuyExit values closer to 50. Setting these values closer to 50 minimizes the movement in the stochastics needed for a position closing, this makes the EA close positions much faster and minimizes loses. You will notice that these two accounts close positions much quicker and hit the stop loss with much less frequency. However, you will also note that the ability to capture profits, although diminished because of the much tighter closing criteria is still yet not totally hindered and large trend following moves are still captured every couple of months (bringing the accounts always into significant profit).

### 8.4.1   Losing Trades

The god's gift ATR only chooses high probability market scenarios which can nevertheless result in a loss. As you know, loses in the forex market are inevitable but the key to actually having a winning system is to cut those loses short and let the profitable trades run. Since the god's gift ATR tries to get in on a trend retracement to take full advantage of a future market move, it is not surprising that the EA starts to fail to a certain degree when higher timeframes Bollinger Bands start to contract and the EA is caught within a tight ranging market. When the ranges a currency pair is trading on tighten, the EA tends to enter trades when the market returns from the top or bottom of ranges, causing some loses. This is seen in the following picture.

Even though not all of our losing trades derive from this type of scenario, all of them arise from the EA thinking the market is trending when it is actually doing another type of behavior. The EA also fails when the market begins deep retracement movements. However, the nature of these loses is pretty much limited and it is the market exposure price that has to be paid in order to have the possibility to catch the large winning trades the god's gift ATR has the potential to actually catch.

### 8.4.2   Winning Trades

After watching the god's gift ATR EA trade live for several months we have seen several great trend catching moves when the EA accurately entered the market on a small retracement and then followed the market into profit efficiently. Most of the time, the trailing stop and internal closing mechanism did a great job at securing high amounts of possible profits. The EA can make roughly 5 to 10% of it's account size on each one of this great moves. In the following pictures you can see some trend following trades taken on the GBP/USD and USD/JPY accounts. You can see that the tighter closing criteria in the USD/JPY did not prevent it from following this trend which effectively was the equivalent of at least 10 consecutive average loses of the USD/JPY account.





It is worth noting that we have just seen medium term trend following success. We have still failed to see the real potential of this EA in live testing as backtesting

predicts we should see (at least in the GBP/USD and EUR/USD instances with lighter closing criteria) trend following trades which can increase equity by even 30% in a single trade. The EUR/USD had such a trade almost half a month after it started trading but sadly I could not take a screen shot of the trade because of a VPS restart which was necessary to update the system. Since we now know this EA to be consistent between back and live testing we should expect to see some very profitable trades of this nature as soon as the market starts to trend strongly. This large winning trades are NOT expected to happen very/ often and should be expected once or twice every year with much smaller (5-10%) winning trades happening every 2 or 3 months. Please be very careful when you choose your account type as choosing the wrong contract size (if you set mini_account to true but your contract size is NOT 10,000 USD) or if your accounts size is ust too low for your risk setting (like having a 500 USD account with Risk = 1 ) will cause the EA to miscalculate your lot size and generate you a much larger risk. Please always start accounts with at least 1000 USD to avoid this problem or any other issues related with money management.

# 9   Trading System Design

## 9.1   Introduction

Without a doubt one of the most interesting and challenging parts of being successful with automated trading systems is the design of useful trading strategies that are able to achieve a positive return in the long term. Designing a trading system is a long and complex process that involves many well defined steps that go from the initial analysis of the market and instruments you wish to trade to the final evaluation of the strategy to know if it is or if it is not worth trading and using. Most people do not know how to adequatley approach this process and they inevitably lose a lot of time before they can come up with a rigurous approach that leads to the mechanical development and evaluation of successful trading strategies. The obstacles people face when they attempt to design strategies are many, including a general lack of knowledge in statistics and a lack of attention regarding the ability to accurately evaluate the strategy that is being designed. Through this section I will explain to you the main process of trading system design and how I have come up with a mechanical and sound way of developing trading systems that have a high probability of being successful in the long term, we will discuss the main aspects of my system development tactics, where you should begin, what you should do, how you can evaluate your success along the way and why this mechanism leads to sound, well-developed trading systems with realistic profit and draw down targets.

## 9.2   An Important Note Regarding Simulations Reliability

The design and use of automated trading systems is mainly based on simulations since we depend on past data to know if our trading system has any merit regarding adaptability, profitability and draw down control. For this reason it is not only important but absolutely necessary and VITAL to have accurate simulations in order to design and use automated trading systems. Before you start the design of any trading system you should put a strong focus on the reliability of the simulations you will be obtaining since if these simulations are not reliable then the whole development effort will be WORTHLESS. The whole idea here is to develop trading systems that can be simulated accurately so that we can know how well they performed in the past and how well they are able to adapt to changes in market conditions. Perhaps the most important reason why we run simulations is to obtain the draw down characteristics of our system, something that cannot be

done accurately if the simulations themselves offer no accuracy.

Because of the above mentioned reasons please ABSTAIN from developing trading systems that have any of the following characteristics :

- Trade on charts below the 1 hour chart

- Systems that use indicator values before bar closes

- Systems that have average profit or loss values below 10 times the spread of the currency pair you are using

- Systems that trade pairs OTHER THAN the EUR/USD, GBP/USD, USD/JPY, AUD/USD, NZD/USD, EUR/JPY or GBP/JPY (other pairs do NOT lend themselves to accurate simulations due to drastic differences in the historical spreads and problems with the historical data)

The fact is that such systems cannot be simulated accurately and even though profitable systems could be developed with those characteristics there is no way in which we can obtain accurate simulations with the current tools available in Metatrader 4 or 5. The use of one minute fractal interpolation as well as the bad historical quality of some pairs, the fixed spreads in backtesting and the neglect of execution factors such as slippage imposes some limitations within what we can and cannot simulate accurately. People who neglect to listen to this advice often end up developing systems with very unrealistic profit and draw down targets that end up wiping their accounts in real trading merely due to the fact that their simulations were NOT accurate and their draw down expectations were greatly underestimated. The best thing to do here is to play smart and develop systems that we know for certain can be simulated accurately to obtain reliable profit and draw down targets.

## 9.3   An Important Note About Statistical Significance

Certainly you may have wondered about all the different observations and suggestions you find within forums and the internet in general regarding system evaluation. Some people suggest you "demo for a month and then trade live" others suggest you "demo for six months, then live in cent account for 2 months, then increase risk slowly". Who is right ? How do you know for how long to test and how to evaluate your trading system ? As an advocate of rigurous evaluation of trading

systems based on statistical principles I have always found these empirircal ob-
servations and suggestions to be misleading at best. For this reason I decided to
develop an adequate criteria regarding testing and evaluation so that I could know
how much testing could be considered "enough" as to better understand how I
should decide and trade my systems.

After dedicating a lot of time to this problem I finally concluded that any
system needs at least a period of 5 years of evaluation to get a good idea about its
trading characteristics. A period of 5 years is statistically significant because it is
representative of a large long term volatility cycle in the market. If you take any
profitable system and analyze it within a 5 year period you will find that it reaches
a new equity high while unprofitable systems are bound to wipe accounts within
this period of time. Since in Metatrader 4 we have enough reliable history to do
evaluations from the year 2000 to present it is viable to do 10 year long simulations
to measure the performance of our trading systems and determine their long term
characteristics.

When you develop your trading systems it is important that you do all testing
through a 10 year period on the currency pair of your choice. Doing this extensive
testing will allow you to see how your system behaves around different market
conditions and how it trades under a statistically relevant period of time. You
won't get fooled my small draw down and profit periods and you will be able to
get a true perspective about the quality and characteristics of your strategy.

## 9.4   Developing Entries

The first thing we usually do when we want to develop a trading system is to
develop the strategy's entry tactic. The entry logic tells the system when it needs
to get into the market and it generally determines a point in time where we believe
a certain outcome in price movement is more likely. The idea with a strategy's
entry logic is to get us into a trade at a point where the movement into favorable
territory is more favorable statistically than the movement into negative terriroty.
Certainly an entry by itself will NEVER determine a system's profitability since
the entry does NOT determine if money is made or lost, this job is done by the
system's exit mechanisms which determine when the system actually takes or
loses equity. It is important to understand that the idea of the entry is merely to
allow us to locate setups where a favorable development of the trade is statistically
more likely than a negative outcome.

### 9.4.1   How do I Figure out an Entry ?

The first natural question that arises when we want to design an entry logic is how to come up with it. The answer to this question is simple and it will allow you to start your system development efforts in a mechanical fashion. The first relevant piece of information we need deals with the actual market movements you are aiming to capture with the trading system you are attempting to design. Do you want to capture short term trends ? Long term trends ? Ranges ? What exactly do you want to do ? Before you start designing your entry mechanism you need to consider what your whole trade setup ideally looks like. Doing this may seem a little bit hard but it actually not that difficult.

The key to do this successfully is to pinpoint a trade setup that you consider is exactly what you want to achieve. Of special importance here is to look at what happened BEFORE you actually would have wanted to enter the trade since this previous market behavior is what determines or "sets up" the future market movement you would have wanted to capture. As an example let us consider the following case in which what we want to capture are long term trends on the four hour charts.



The image above shows you what I considered here an ideal trading setup and

when I would have ideally wanted to enter the market. Notice how this entry would have put us in a place where all movement would have been towards the favorable movement after the trade was entered. The tricky thing now is to device an entry logic that would have put us in that place that stores the fundamental characteristics of the trading setup we want to achieve. The technique can be simply price based or it can use an indicator that is able to convey the basic information regarding our entry setup (both cases are shown on the images given below). The important thing here is to remember that you have to capture the setup you want that will let you enter your trade right where you want.
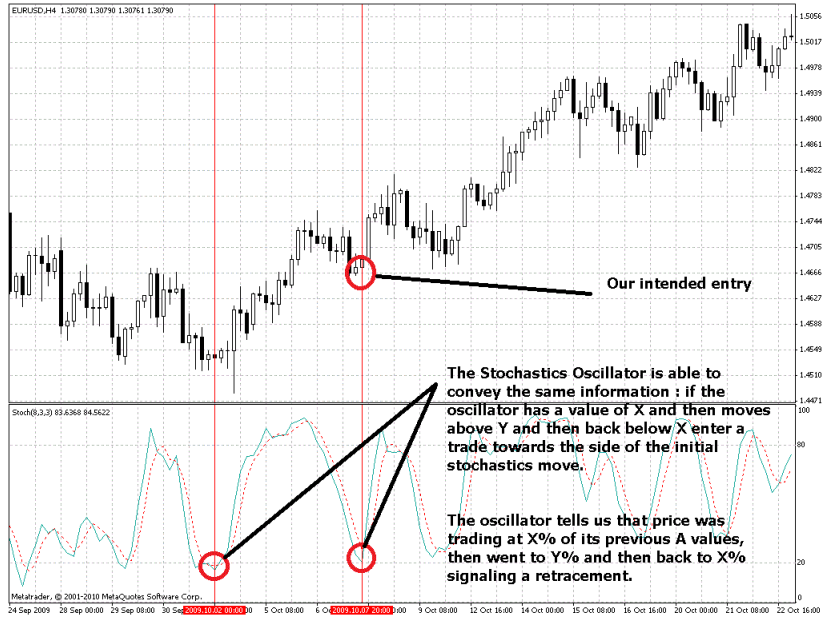
After we finish the development of our initial entry logic that will let us get into the exact trading setups we want, it is time to see if this trading setups lead to statistically meaningful results over the long term. This takes us to our next topic which is the Mathematical Expectancy of entries, how you can measure it and how it will allow you to accurately and quantitatively measure the quality of your entry logic.

### 9.4.2  The Mathematical Expectancy of Entries

Perhaps the chief reason why most people fail with their attempts to create successful trading systems is rooted in the fact that they never do an adequate evalution regarding the potential of their entry logic. If the entry logic of your system does not lead with statistically significant results into favorable territory then your trading system is bound to be unsuccessful regardless of how much effort your put into your exit logic or money management. This is exactly the moment where unsound trading tactics such as the use of very large risk to reward ratios and Martingale systems arise, the failure to get a good entry logic makes people attempt to improve their trading system by using "artifical methods" such as the above mentioned unsound trading tactics that tend to improve short term results but eventually the market cashes on the system's exposure and wipes the accounts.

However there is a simple way in which you can evaluate the quality of your entry logic and measure its potential before comitting yourself to the design of a full trading tactic based on your initial entry logic developments. This study called "mathematical expectancy entry analysis" allows you to calculate the maximum average moves into profitable and unprofitable territory after a set number of bars of a given entry logic on different time frames. This analysis can be done using the mathematical expectancy analysis tool located within the Asirikuy systems section. You should watch the practical and theoretical mathematical expectancy analysis videos included within the Asirikuy training section to learn more about how this analysis is done in practice and how you can do it for your own entry logic.

Once finished, the analysis will give us a lot of vital information about our entry logic, it will tell you if the mathematical expectancy of the system is positive and on what time frame and along what number of bars it is more positive. The actual amounts of the maximum averages will also allow you to design the exit logic of your system since it will allow you to place dynamic SL and TP values based on the 14-daily ATR as a first approach. This study will also allow you to see if your system actually captures the movements you wanted or if it is better suited at capturing shorter/larger movements or moves on other time frames.

For example if you do a mathematical expectancy of your system and your maximum movements into postivie territory for longs and shorts are 65 and 70% and the moves into unprofitable territory are 50 and 60% of the 14-day ATR for a 100 period analysis then your system has a positive mathematical expectancy on entries of +15 and +10% showing you that your entry leads into profitable territory with statistically greater favorability. You might then select initial SL and TP values of 65% since this value leads into your TP in average while the average of the move into losing territory is smaller (60%) meaning that it won't be reached in average.

If the mathematical expectancy analysis of your strategy is negative, do not despair. You will often see that unprofitable systems have unsymmetrical mathematical expectancy measurements (for example longs have a positive expectancy while shorts do not) something that means that your system has the same potential as a random entry. Systems that have negative mathematical expectancy on both values can be reverted to arrive to a system with potential while systems that have unsymmetrical values simply have no potential as I explained before. If your sys-

tem is unsymmetrical, go back to the drawing board, reselect your ideal case, look into other options, look into the ideal setup of your system and come up with other entry choices. If your system has a positive mathematical expectancy on entries then it is time to start the hardest part of its development :o).

### 9.4.3   A Warning About Entries

I have frequently noticed that people tend to obcess with entries when developing trading systems and that this often leads to systems that have extremely complex entry logic sets that still don't lead to systems that have any long term potential. Failure to do the above mathematical expectancy analysis and a lack of focus in the developing of adequate money management (lot sizing plus exit logic) tactics makes this problem very common and largely responsible for the failure of most "community" developed trading systems available online. Often you will notice that on forums systems become more complex with time often starting with entry filter restrictions and usually evolving and ending with such things as "recovery modes", Martingale implementations, etc. My advice here is simple, focus on the development of simple entries with a positive mathematical expectancy and then put the majority of your effort in the development of the money management part of your strategy. Do not make your entries overly complex in an attempt to "improve" your system !

## 9.5   Money Management - How Much to Trade and When to Exit the Market

The part of your system that deals with how much money you put into the market and when positions are exit is what I will call money management. Entries determine the potential of a given trading system while money management determines the true profitability and characteristics of the strategy. Having an entry with a positive mathematical expectancy ensures that your system enters the market with the knowledge that across a large sample of trades movements will happen predominantly towards your side while how many lots you trade and when you exactly exit the market determines how much money you will be making or losing. In the end a system with a positive mathematical expectancy on entries can become unprofitable if the money management is not adequate while an adequate implementation can bring to light the full potential of the entry logic.

### 9.5.1   The Extremely Simple Principles of Money Management

When we are developing lot sizing and exit rules for our trading systems there are some very simple principles we need to consider. Keeping them in mind while you develop and design your strategies will ensure that your system evolves towards a sound path and that your system design will indeed lead to the development of a trading system with a good risk to reward ratio and sound trading characteristics. These principles have been mentioned before and they constitute the basis of profitable system development regarding money management :

- Cut your loses short. This principle simply tells you that you should do a big effort to make your losing trades as small as possible. In practice this means that you should put a big focus on those trades that go directly into draw down territory so that you might find an exit logic that makes them as small as possible.

- Let your profits run. This compliments the above principle and tells you that you should let your profitable trades achieve their potential. Contrary to popular belief this does not mean to put a trailing stop and let a percentage of your position have the potential to "hit the jackpot" but to let your trades reach their true potential according to what your trading system wants to achieve. Letting your profits run is about making your trades remain open while the possibility of a favorable movement remains high.

- Control your risk. Something that new traders generally forget is that risk should be controlled if long term success is to be achieved. The amount of equity you risk per trade should be controlled and no trade should take a substantially higher loss than another. Trading systems that have "recovery modes", D'Alembert systems or Martingales and increase risk as losing trades increase are NOT going to allow you to reach long term profitable and they are especially dangerous since small errors in simulations may imply GREAT underestimations of draw down. So ALWAYS make sure your system doesn't use progressive lot sizing and always use a sound risk of capital per trade.

- Adapt to market changes. A system should be able to react to changes in market conditions. A big part of the success of a trading system is based on the fact that it can adapt to changes in market conditions and get a profit in the long term regardless of how the market starts to evolve. Market volatility

provides us with a great tool we can use so that our trading system's money management can change as the market starts to evolve.

### 9.5.2  Coming Up with an Exit Logic

What separates good from excellent trading system developers is the ability to come up with exit mechanisms that are able to cut losing trades short and let profitable trades reach their full potential. The development of adequate exit mechanisms is necessary for a system to reach its full trading potential and this can definitely only be done through the analysis of 10 year backtests. Of course, in order to backtest your system you first need an initial money management implementation that will allow you to start to do some analysis and make improvements. Since you have done a mathematical expectancy analysis of your entry the values given there will allow you to have a good idea of what ATR% adjusted SL and TP values you could use while you can use a % balance adjusted loss against your SL so that you risk a fixed percentage of equity on each losing trade.

What comes after you do this is perhaps the hardest part of system development, the creation of exit mechanisms. The first thing you need to do in order to achieve this is to run a ten year backtest and go through all the trades within the test. The trades we are most interested in are trades that go into losing territory without touching profiable ground, these trades are the most unfavorable and they are the ones we need to counter the most. Once you pin point ALL these trades within your 10 year backtest you should take screenshots of each one and analyze them to see what they have in common and what makes them different from profitable trades. The idea here is that you should device an exit mechanism that allows these trades to be cut short without affecting other trades which did turn out profitable. Sadly there is no mechanical way to develop exit mechanisms since each different system has different exit mechanisms that may suite it better. What you need to clearly understand is that the idea here is to exit losing trades quickly and to let profitable trades reach their highest potential.

Of course, another important aspect is to determine when profitable trades significantly lose their probability to reach their full potential. You might want to analyze trades that go significantly into profitable territory and then reach the SL so that you might find out what they have in common and what "signals" that a trade which was entered is no longer likely to reach its profit targets. These exits are also very important since they allow us to exit trades when the setup that first

60

triggered our entry has become invalid.

Perhaps the best way to show you how to find and implement exit mechanisms is found within the Watukushay Project (next section) which explains to you how I developed the exit mechanisms of several different trading systems available within Asirikuy.

## 9.6   The Cycle of System Development

As you see developing a useful, reliable and profitable strategy requires the use of many different procedures and skills. In order to make the process more straight-forward I have also developed a flow diagram that shows you the main ways in which you should develop trading systems and the paths you should follow. Obviously the development diagram shown below fits my particular way of designing and programming strategies but probably such a method won't fit some of you and adequate modifications to fit your particular development personality will become apparent. Nonetheless, I believe that the basic logic of the diagram is very sound and anyone who follows it precisely is bound to come up with a high quality trading system that is likely going to be long term profitable.

**General System Development Scheme**

Defining the potential of the strategy

Entry Development

↓

Mathematical expectancy analysis

bad results (negative expectancy)

good results (positive expectancy)

10 year Backtesting

↓

Exit Development

bad results (no improvement)

10 year Backtesting

System for Testing

good results (improvement)

**Entry Development**

Establish setup you wish to exploit
(one week trends, daily trends, hourly trends, etc)

↓

Look for an ideal entry

↓

Establish entry rules by analyzing price action prior to ideal entry

↓

Do a mathematical expectancy analysis

Find common entry criteria for all ideal entries established

Find another ideal entry

negative expectancy

positive expetancy

Repeat the analysis on different timeframes and periods

↓

Choose the results with the highest expectancy

Continue to backtests and Exit development

trade sets to focus your analysis on

Analyze profitable trades end up only slightly into positive territory

choose one

Run a 10 year backtest

**Exit Development**

Divide backtest onto different trade sets

System ready for testing

Analyze all trades that are in profit but then end up at the SL

Choose trade set to analyze

yes

no

Analyze all trades that go directly into losing territory

Are the characteristics of the system good enough ?

Design Exit Criteria

no increase in profit factor

Remember to choose optimization results that give reliable simulations and adequate statistical significance !

Optimize non-logic related exit criteria (SL, TP, etc)

Run a 10 year backtest with the new exit

increase in profit factor

Optimize entry related criteria

Optimize exit related criteria

# 10 Understanding Draw Downs and Thinking About Worst Cases

The easiest way to fail in automated trading is to lack an understanding about the trading characteristics of the expert advisors you intend to use. It is therefore quite easy to see how many people lose their accounts and get surprised when their automated trading systems start to show great loses and big and deep draw down periods. Commercial EA sellers never talk about the potential risk of their trading systems something which is vital to know for anyone who intends to trade a system successfully. However, besides the maximum draw down and other draw down characteristics displayed by the metatrader strategy report there are other very important draw down measurements we need to take into account in order to accurately evaluate a trading strategy and get an idea about the way in which this strategy behaves in trading. This section will talk about these important characteristics as well as how you can figure them out and how they allow you to calculate accurate worse-case scenarios for your trading systems.

## 10.1 Gabor's Profit and Draw Down Analysis Tool

Gabor (who is an Asirikuy member) has collaborated with me in the development of a profit and draw down analysis tool to help us analyze our backtesting results and better understand how our experts behave in the market. The tool calculates all the different draw down and profit related characteristics of a trading system, giving us some extremely valuable information that the default metatrader strategy analysis does not provide. Amongst this information we can find results regarding monthly and yearly profitability, draw down period lengths, their depths, portfolio analysis, etc. This program is a GREAT tool that allows us to deeply analyze the draw down and profit characteristics of our trading systems, making sure that we have a very accurate picture of how our systems may behave in the longer term. If you are interested in using this tool please watch the videos about it (available within the training section) and download the software within the trading system's section. Please make sure you watch the videos since the setup of this program requires you to install a MySQL server (this is a free program).

## 10.2   Draw Down Periods

Trading systems regularly go into different profit and draw down cycles along their trading life. This happens mainly because the appearance of inefficiencies within the market is somewhat cyclical meaning that a system can profit under some market conditions while it cannot under others. The idea is that while profitable conditions remain the system is very profitable while under draw down conditions the system limits its loses and focuses on attempting to capture the possible start of a profitable period. All long term profitable systems will attempt to discourage their use through their draw down characteristics meaning that they will all suffer deep and extensive draw down periods which aim to discourage the trading of the system by those people who do not understand them and do not know that these periods constitute a normal part of the expert advisor's trading. Automated trading system psychology plays its biggest role here since most long term profitable systems are in fact tremendously hard to trade from an emotional point of view since many of them will put their owner to the test with draw down periods that will only be overcome if the trader understands the characteristics of the trading system.

As I have said a few times within the book our most important weapon against these draw down periods is to understand them and be prepared for their occurrence. In order to do this we need to understand some vital characteristics of a trading system which are the maximum draw down and the length and depth of its draw down periods. As an example let us consider the God's Gift ATR draw down characteristics.
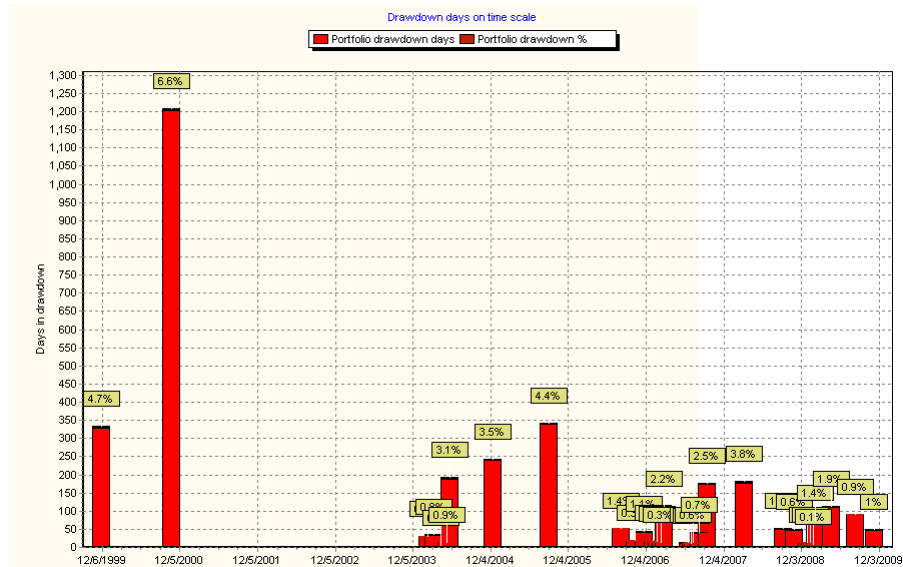
The image above shows us the appearance of different draw down periods along a 10 year backtest from Jan 2000 to Jan 2010 on the GBP/USD using the settings of the FXDD live account within Asirikuy's test section (only Risk was changed to 1 from 3). The image shows us that the largest draw down period began in 2000 and amounted to a draw down level of 6.58%, a draw down period which lasted all the way until 2004 when the system managed to achieve its next equity high. This means that the system had a draw down period of 3 years showing us that this could also happen in the future. However it is worth noting that this draw down period was controlled and the EA was able to cut loses short during this whole time when the system's trading did not achieve new equity highs. After this draw down period ended the system more than compensated for the three years of loses with the achievement of new equity highs every year until the end of the test.
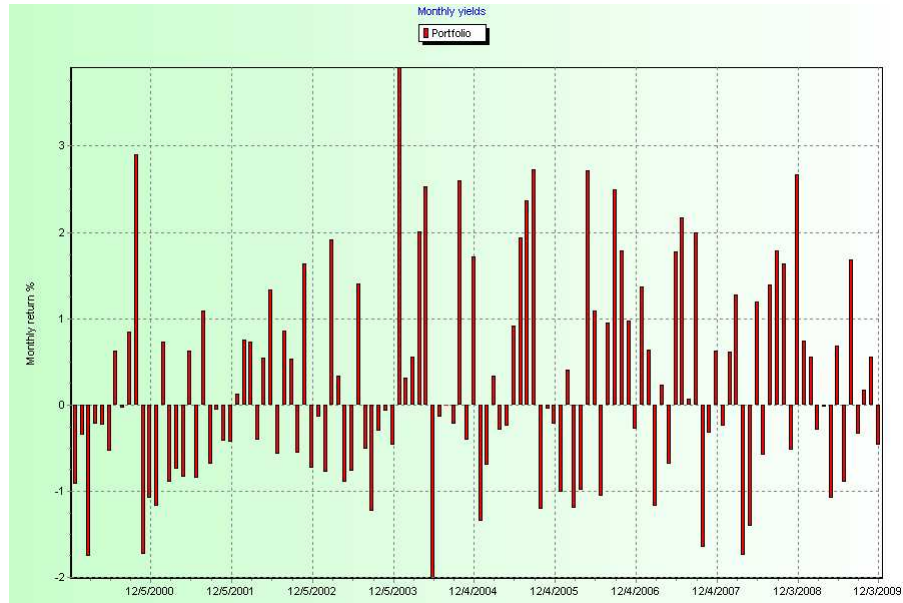
The last image shows us the monthly profit of the EA for the 10 year period, we can see that unprofitable months are almost as frequent as profitable months but the average profitability of profitable months is almost twice as large. This is in line with the system's trading tactic that waits for large trades that amount to a great majority of the system's trading profits. Even though trades taken by the God's Gift ATR do not frequently reach their highest potential those that do make up for the losses taken by the EA during unprofitable periods.

A person trying to trade this EA without the above information would easily desist from trading it after a break even year while a person with the above information understands the system's trading tactic and KNOWS that the system's characteristics predict periods of extensive draw down which are followed by sharp profitable periods that make up for all the waiting time. However this does NOT mean that systems should be traded merely on faith since a system can become too risky to be traded, reason why we always need to have a worst case scenario that tells us if we should or if we should not continue to trade a given strategy. Learning how to come up with this worst case scenarios will be the subject of the next sub-section. Part of why automated trading is extremely hard lies in the fact that long term profitable systems are emotionally discouraging to trade in the short or even medium term, reason why understanding is a HUGE part of success with automated trading systems.

## 10.3   Worst Case Scenarios

One of the things that has allowed me to become successful in the world of automated trading is the fact that I have a very in-depth knowledge about the trading characteristics of the systems I use and develop. When you have a very good understanding about the make up and character of the draw down and profit cycles of your system you are able to remove emotion and let your system execute itself as it is meant to, knowing that in the long term the system will bring you profitable results through its sound trading tactics.

However it would be naive to think that a trading system cannot become too risky to be traded and relying solely on blind-faith to trade a system is also bound to cause account wipe-outs. Even though a system may have 10 year backtests and live/back testings consistency the possibility remains - as I have mentioned before within this ebook - that the EA will become too risky under new market conditions it had not been put through before. For this reason I came up with a model in which a worst-case scenario is setup such that if this worst case scenario is reached the trading system will become obsolete and "too risky" to be traded.

The worst-case scenario is nothing more than twice the maximum historical draw down of a system over a ten year backtesting period. This allows us to continue to trade the system even if worse market conditions that pull the system below its historical maximum draw down levels do appear. As a matter of fact this is something we can actually expect since future market conditions are bound to put the system into worse trading conditions than what it has faced before. However if a system reaches twice its previously achieved maximum draw down it means that the system has become considerably deteriorated under current market conditions losing a big part of its adaptability and its maximum draw down to average compounded yearly profit ratio characteristics. For this reason ANY system that reaches a maximum draw down greater than twice its 10 year backtesting draw down would have reached a worst-case scenario and its trading will be stopped thereafter.

What you have here is a trading plan with a TOTAL focus on the draw down characteristics of the trading system you are using. Knowing the system's worst case scenario allows you to have a plan and to know the exact amount of equity you will be risking for a given long term gain. You will find with time that the MOST important thing when living from trading is to control your loses and hav-

ing accurate draw down period analysis and worst-case scenario estimations will be VITAL for your success as a currency trader, especially when dealing with mechanical trading systems.

## 11 Portfolio Trading - Increasing Profitability and Controlling Draw Downs

One of the greatest developments we have achieved in Asirikuy has been the ability to analyze and trade portfolios of our different systems. Most importantly, we have been able to get accurate profit and draw down figures for portfolio trading which allow us to project future worst case and draw down targets that allow us to trade our portfolios with a lot of confidence.

In portfolio trading, what you want to do is to trade different systems to reduce your risk and increase your profitability. Since each system has a different market inefficiency whose market exposure is cashed at a different time - in theory - putitng two trading systems together will lead to an addition of their profits without a significant increase in their draw down level. To put it in simple words, when a system goes into draw down it is hedged by another one and when the other system goes into draw down, the same thing happens; however, since both systems eventually recover from their draw downs the end profits add while the in-between draw downs do not. The end effect of this mutual hedging and profit accumulation is a great increase in the average compounded yearly profit to maximum draw down ratios, achieving values of even 1:3 in simulations.

Since the metatrader 4 platform does not allow us to run backtests of multiple systems we have come up with a way to pair up the 10 year backtesting results to obtain accurate "joint" portfolio results. We do this by using an internal balance implementation which makes each EA adjust its lot size exclusively in virtue of its own profits and loses. This adaptation makes each expert behave in live trading as if it was trading in an entirely different account from the other systems. This implementation allows us to join 10 year backtests and use the results to calculate portfolio draw downs in exactly the same way as they would have happened in real trading since the systems trade independently without the results of one ever affecting the other.

However if this internal balance is used to evaluate 10 year portfolio draw downs and profits and there is even a slight difference in the profit and draw down characteristics of the different systems used, the draw down and profit targets may become very dependent upon the portfolio's starting point since the most profitable system will contribute the majority of trading after only a few years. To eliminate this problem we have introduced a "reset technique" in which the portfolio's internal balance is reset every year, this allows the systems to trade independently through the year and then their profits and losses are reset so that their new internal balance becomes the account balance at the end of the year. With this reset technique we can obtain accurate profit and draw down targets without a strong dependency on the portfolio's starting point, effectively allowing us to evaluate 10 year portfolio profitability and draw down without the risk of having strong underestimations of draw down.
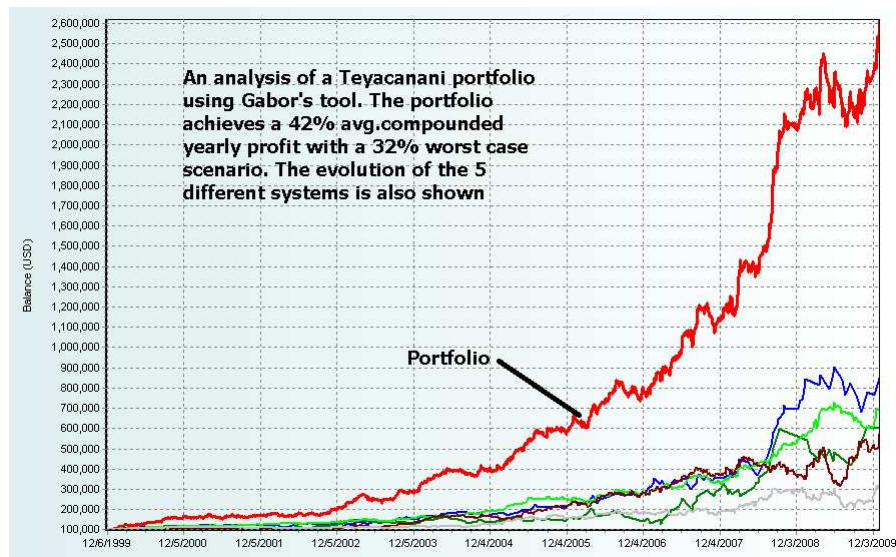


Of course, an important point here is also the underestimation of open trade draw downs since the portfolio analysis we do does not take into account any draw down that is not realized through closed positions. For this reason it becomes important to bear in mind that this analysis is only valid for systems for which any given floating draw down at one point is limited. Systems like Watukushay No.5 and Kutichiy where the number of opened trades is potentially limitless and therefore the open draw down may contribute to a significant increase in the maximum draw down should use a worst case scenario of at least 3x the draw down from the

portfolio analysis.

Our analysis of portfolio profit and draw down figures is currently done using Gabor's draw down and profit analysis tool which allows you to load the 10 year backtests you want to evaluate and choose an appropiate reset period. You should watch the videos about this analysis tool as well as the SQL scrip and VBA macro videos so that you get a better understanding of how this is done and how the actual analysis within the tool is implemented to give us the best possible estimations of historical portfolio profit and draw down targets.

# 12   The Watukushay Project - Programming your own Automated trading system !

## 12.1   Introduction

After a few years of getting to know automated trading systems and the people who usually look for automated trading systems I have realized that there are two main road blocks that prevent people's realization of profit in the forex market. The first road block is ignorance. When I say ignorance I mean ignorance about many things, about the market, about programming, about indicators, about trading, etc. The second road block is disinformation. Basically people are ignorant and then they are filled up with lies by expert advisor sellers. These lies include such things as unachievable profit targets, stupid claims about the easiness of automated trading, how you can make money without doing anything, etc. I have to say that I am completely fed up with this. For this reason I have created this section called the Watukushay expert advisor project. Within this section you will follow the step by step process to actually make an expert advisor, how I literally think about every step of the process, how I implement them, test them, etc. This section will allow you to see all the logical process involved in expert advisor creation and will give you a broader understanding of everything a system must have and everything that must happen in the process to create and evaluate a long term profitable expert advisor. My intention here is to develop an EA with similar characteristics in trading frequency, profit and draw down targets as the god's gift ATR but showing you exactly how each step of the process is done.

### 12.1.1   Watukushay, from Quechua meaning "to care for"

I chose the word Watukushay as a name for this automated trading project because it reflects the things I believe in. Watukushay is a word in Quechua that is better translated as a verb : "to care for" because my objective with this project is to show you that I care about how you do in automated trading. I want to show you how all the steps in the process happen so that you too can follow them and develop your own profitable trading system. You will see that the actual making and programming of an EA is not very difficult and that you too can actually build and trade your own profitable system if you actually know what to aim for. Of course, this first version of the section may leave a lot of room for improvement as I certainly cannot put a whole programming book into my ebook's section but it will be improved with time and I hope that in the end it will definitely become

a reliable source for people willing to learn all the things that have to go through the process of building and making an automated trading system. Now please join me on this exciting journey for expert advisor creation !

## 12.2   The "hard part", deciding on the main logic of an automated trading system

In order to create an automated trading system we first need to understand what composes an EA and what parameters we need to define in order to program one. A trading system in general, to be automated, has to have the following minimal features : An entry criteria, an exit criteria and a money management criteria. That is, we must know how much to trade, when to trade it and how to trade it. This section will focus on how you can decide what suites you best and what I chose for the first EA of the Watukushay project. My idea with this is that you go through all the same experience as I did creating this EA so I would be very glad if you follow all the same steps I take and arrive at the same end product.

### 12.2.1   Where is our profit coming from ?

The first thing we need to look for when developing a profitable automated trading system is where our profit is coming from. What fundamental characteristic of the market are we going to exploit ? Up until now, the only characteristic I have found a system can exploit profitably in the long term is a trend. I have not found any other way to trade that can generate profits in the long run. This of course, is based on all the facts I already explained about market randomness, etc. People who are more interested in this subject should also research the concept of "market efficiency" in particular, you should realize that in order for technical trading to be profitable, the market must be inefficient to some degree, something which almost certainly only happens with trends in the long run. The market quickly becomes efficient to anything that could predict future prices in lower time frames making long term profitable systems based on things like scalping, in fact, impossible. To make it clear, the development of expert advisors I will focus on on this project will be aimed only at trend following systems. Our objective will be to capture trends and to follow as close as possible all the guidelines I highlighted earlier on the ebook.

### 12.2.2   Indicator based or Price action based ?

This is a question I do get with a certain frequency. Should we make an EA based on price action or on technical indicators ? My answer is always the same. Is there any difference ? Indicators are just mathematical operations over price which allow us to see information about the former in a much more organized way. Trading with price patterns or price information directly is not different than trading with indicators in the sense that price continues to be the underlying information that is being used. We will try to focus on trading using indicators because programming using direct price action can be more troublesome while programming using indicators is fairly straightforward and more accurately controlled. On a second note, trading on indicators makes backtesting more reliable as direct price calculations that rely on intruder prices may be affected by one minute interpolation errors in ways which are extremely hard to predict.

### 12.2.3   Entering and Exiting the Market, what do we want to do ?

This is one of the most important points you come across when developing an expert advisor. When are you going to enter a trade and far more importantly when are you going to exit the trade. What do you want to do ? Ideally, we would want to get into trends before they start and then exit them when they are about to end. That is, we want to trade from a top to a bottom and from a bottom to a top. This is actually impossible and trying to achieve this will only get you loses. The market does not allow such moves because it plays a probability game. The market defends from prediction by becoming efficient. If there was ever a way to enter a trend before it started and then getting out just before it ended it would have already been exploited and this would have removed the advantage from using it. The market becomes efficient to the prediction. Now, this means that whenever we want to enter a trade, we must do so after it starts. So what we are saying is that the market obeys a momentum driven condition. We are implying that price will want to go further along a path that has already been started. This has been proved to be the case in many different trading instruments which follow trending periods that can last from hours to years.

So now that we know we want to enter a trend after it starts but as soon as we possibly can we must ask ourselves another question. How long do we have to wait before we enter ? We need to have a good probability that a trend has actually developed and that we are not in a ranging market but we also want to be able to

achieve a significant profit from the trend's movements. This is a tricky part and this is the part where most traders believe the actual "gold" is. Well, it is actually not. Entry points in the forex market are totally irrelevant because anytime you enter a position you have a chance of being profitable either way . The exits, on the other hand, are vital because they determine whether you were profitable or not on the trade you took. A rather common exercise when learning how to trade the forex market is to flip a coin and enter a currency pair either long or short depending on the result, then the trader decides how to actually handle the trade. This is the most important thing you must know how to do. Just so that you can follow the concept I would like you to try this for two weeks. At a fixed time each day of the week, on the EUR/USD, enter a position either long or short according to the results of a coin toss. Then decide how you will handle the trade, how much will you trade and what conditions you will employ to exit the trade. You will notice that handling exits is far more critical than handling entries.

### 12.2.4   Deciding on our first indicators

After deciding exactly what we are after, we now have to decide which indicators we must use to achieve our designated entry strategy. What indicator will we use to allow us to enter a trend after it has started but has not yet finished ? You should think in an extremely basic fashion when dealing with these questions. A trading system is far more accurate and easy to evaluate and understand when it is started on a very simple basis and then elaborated towards a more complex type of system (if this is at all necessary).

A very simple system that lets us within a trend after a certain time has passed from it's beginning is a moving average cross. A moving average is simply the average of price calculated over a certain number of periods. A moving average cross is simply defined as when the average calculated over a period changes from being higher to being lower than the average from another period of time. It is important to understand the logic behind using a moving average cross. What does it mean ? When the average of price in a long period of time is, for example 10, this means that 10 is the "expected value" of the instrument, if the average of price over a smaller period is, for example 8, then this means that price is trading below where it is expected to be traded. Certainly, depending on the market conditions, two things can happen, if the market is just ranging, then price is bound to return to its average value which is the "accurate value" of the instrument. However, if the market is trending, then the moving average will move to lower values because

price is changing rapidly in relation to its long term average. When the average of price on a shorter term crosses over the average of a longer term it means that, if the market is going to trend, then we will get in at a good point. If it is not, then we are going to lose as the market will try to return to its previous mean value. The fact that this possibilities exist is what defines the market exposure of this system. By taking the moving average cross as if it signaled a trend we are exposing ourselves to the times in which is does not.

The longer the timeframe we use for the moving average, that is, the higher the number of periods of the long term moving average, the more reliable the signals will become but they will also become far more infrequent. But where do we start ? A good place to start would be at a 250 simple moving average cross against a 15 simple moving average cross. This is a system that has actually been studied before academically to prove market inefficiencies in the forex market (this study was done in 1985). Now, another important problem arises. What price will we use to calculate the moving average ? It clearly depends on which bars your going to trade on. You must keep in mind that the system must be backtesting reliable which means that we must enter trades on a bar opening price, something which will guarantee we will have no one minute interpolation errors on entries (which is very important !). So there are mainly two options. You can either enter trades based on the cross of two moving averages based on closing prices with a 1 bar lag or enter trades on the same cross but based on moving averages that use opening prices and then you could have no lag and enter the trade as soon as the bar opens. Which strategy is better ? Truth be told, both of them are roughly the same because the lag you save when you use opening prices you gain because of the difference between both. Please note that you could tell the program to use a moving average close with no lag and it will backtest without errors and with billions in profit but that is only because the EA knows the closing price of a current bar (it looks into the future) so we should always take into consideration the actual logic of the things we are telling the computer. Please remember that computer do not solve problems, they execute solutions.

For now we will not consider how to filter the aforementioned "ranging trades" that will obviously cause a lot of loses in our present system. For now we will just build a system based on a 15 SMA (simple moving average) cross over a 250 SMA. System rules in plain English would be "enter a long when the 15 moving average moves above the 250 moving average and enter a short when the reverse happens". Now, for a computer, this language would just be too vain because

many things are not said. You should take into account that a computer needs to know every detail about your system to execute it correctly, so a much better rephrasing of this scenario would be "if the 15 moving average calculated on closing prices is less than the 250 moving average calculated on closing prices two periods in the past and it is above the 250 moving average calculated on closing prices one period in the past then enter a long, enter a short for the reverse situation". A computer would definitely understand this because it is the "logical" way of explaining it. The concept of "cross" is ambiguous and such a system would not work because the value of a moving average can move above or below the other one or many times within a single candle, in order to be completely sure that the signals have been generated accurately and have no errors about it we need to look into the past and check if a cross occurred on the candle before the candle we are currently on because we need the cross to actually have happened. There are thousands of crosses that happen while a bar is opened that you simply do not see, we need to filter all this out and just keep the ones that DO happen.

### 12.2.5   Exiting a Trade

Now that we know how we are going to enter the market the hardest thing becomes to decide the rest. How will we get out of the market now ? To answer this question you need to actually think about several things. When do we want to get out ? What is the cost of getting out when we want to ? Of course, we know that we would like to get out of the trade when the maximum amount of profit is reached (the trend runs out) and we can actually achieve that but then, what is the cost of doing that ? If you want to catch the whole trend move you will have to allow a lot of market exposure because you are opening possibilities. For example, the market may retrace significantly along a trend so we would have to get a large stoploss which would in some cases be touched, and this cases would give as further loses than the profits we get from actually getting everything we can. So we actually need to rephrase the question. When can I get out, so that I am able to accumulate profits in the long run ? Much better ! The truth is that we don't know the answer to this question and it is most likely something we will have to find out by optimization. However, certainly we will need some sort of adjustable system to get in and out of the market so that volatility changes don't take a big toll on our profitability. For this reason we will use an adjustable ATR Stoploss, Take profit and Trailing stop, programming all this into the EA will allow us to see which one is the actual best strategy for our system. There are other exit strategies that are adjusted with volatility implicitly such as exiting on

a slower moving average cross, for example, a 25 moving average. This strategy is also valid and probably a combination of both of this should be the best in the future but as I've said, the optimizations we will run in the future will tell us this in a much more explicit way. So keep in mind we will exit the market on ATR adjusted stoploss (SL), take profit (TP) or trailing stop (TL).

### 12.2.6   Money Management

Probably this is MOST critical aspect of trading and where people fail the most. I have seen hundreds of traders that have systems that actually have decent entries but that have awful exits and money management (usually just a percentage of equity) so they think that the problem is with their entry and they add a zillion more indicators to try to filter every possible trade where they are failing out. This is the WRONG approach. As you may have seen on my blog, it is actually easy to make a system profitable by giving it the adequate conditioning. Money management plays a VITAL role and it does make the difference between a profitable and an unprofitable trading system. For example, the turtle trading system, without the ATR adjusted money management wipes an entire account in less than 2 years when you try to backtest it but it turns profitable with this addition. Money management is greatly underestimated and extremely important. You should also take into account that trading "x percent of equity" is NOT money managing because money management takes into account THE MARKET and this strategies completely ignore the market and just relies on account balance. A proper money management system should take into account : the market, your equity and the risk you want to take with the system. All of these THREE THINGS are completely vital and any money management system cannot be called one if it ignores one of them. For our trading system we will include a simple yet extremely effective method of money management based on the ATR indicator which fits very well with our previous choices. This ATR adjusted scenario is a very good choice when there is not a very clear way of where to actually start looking. However there are many alternatives to exits and money management, for an example of these you would want to look into my GBP/JPY daily breakout system which uses a "market range" defined by an hour breakout period as a measure of volatility with which it calculates the exit strategy.

### 12.2.7   Our logic up until now...

To summarize things up a little bit we are going to program a basic expert advisor that enters the market on a cross of a 15 SMA over a 250 SMA with an ATR defined lot size and exits the market on an ATR adjusted Stop loss, take profit or trailing stop. We will program and optimize this expert advisor for the GBP/USD hourly which I decided to use because it is a highly trending pair and the hourly time frame is, in my opinion, the lowest time frame in which you can have good trend following trades with good levels of profitability in the long term. Of course, you are extremely welcome (and you probably should for practice !) repeat the process I will walk you through on the EUR/USD and USD/JPY which are two additional trending pairs. Please, do not try to optimize or use this system on crosses, USD/CHF or other pairs that are highly volatile and non directional. If you have understood the logic behind this you will realize that it will just be a waste of time and you will NOT be able to realize the long term profitable results we are looking for !

## 12.3   Programming your first MT4 Expert advisor

Now we are going to start the fun part. First things first, don't be afraid of programming ! Programming is nothing more than giving a computer a set of instructions it can execute. You will see that with the tools I'll give you and the way in which I'll explain it you will have no problem programming this and hopefully other expert advisors. Even though the code of the finished expert is available with the ebook I encourage you to do all the programming of the expert as this will allow you to see HOW it is done and it will let you do modifications, play with the expert, understand it, understand other experts and then continue your journey in the world of automated trading in a much more confident and knowledgeable way. Say this to yourself, it will require work, but it is something that will reward you a lot in the future and it is something you will definitely need if you want to become truly profitable in the world of forex automated trading.

### 12.3.1   Programming our logic, a practical way to get it done

In order to make it easier for the average person to program their first expert advisor without having to acquire extensive knowledge about programming before hand I spent a while looking for tools that could help people program an expert advisor easily. I found that a practical web applet developed a few years ago

serves a great purpose as a way to develop the main logical base for our expert advisors. This applet is located at the following web address : http://sufx.core.t3-ism.net/ExpertAdvisorBuilder/ . We will use this tools to build the overall logic code for our expert advisor and I will then explain all the different aspects of the code as well as where, how and why to introduce the modifications we will do in order to really adjust the expert to our needs. Building an expert this way has several advantages over trying to teach people how to build this from zero. The code will be already optimized against errors and it will be clean, polished and very easy to modify. It is the perfect way for people to start building their own indicator based expert advisors. During the next few pages we will use this website so please go into it so that we may start our coding process.

### 12.3.2   Introducing the entry logic

Now we want to introduce the entry logic into our expert advisor. You should go to the "Buy strategy" button and click on it. Now you should change the values on the drop down menus to fit the values shown on the image below.

After you finish with the first one click the "add" button and introduce the second conditions into the logic. What we are saying here is pretty simple :

- Enter a long trade when the 15 moving average of the second bar in the past (shift=2 means two bars in the past, 0 is current bar, 1 is bar before, 2 is bar before the bar before, values in green rectangles) is below the 250 moving average and the 15 moving average is above the 250 moving average in the first bar in the past.

- As you can see, this is the logical way in which you would express a crossing logic, the value of the 15 MA was below the 250 moving average and after it was above.

Please note we are using the first closed values in the past we can find because we need values for the MA that have already been defined, if you tried this on the

current bar (in real trading) , the value of the MA would change constantly since the close of the bar has not been truly defined and the average is continuously recalculated (in real life this would mean lots of fake signals). This also gives MEANINGLESS backtesting results because the backtester uses actual bar closes so it "sees into the future" you trade bar closes of bars that have not closed. So please do NOT change these Shifts and tell me that it is more profitable because it obviously is since you are exploiting a backtesting failure. The current approach ensures that no exploiting of backtesting faults takes place, something you must always be very careful about.

Introducing the short logic is pretty much the same but with the reverse logic. Give it a shot ! Now go click on the sell strategy button and add the two trading conditions but reverse the > and < signs so that the logic becomes this :

- Enter a short trade when the 15 moving average on the second bar in the past is above the 250 moving average on that bar and the 15 moving average is below the 250 moving average in the first bar in the past.

You see ? It really is not that hard to build a simple expert advisor like this ! As you can see, this introduces all of our entry logic. Now, we don't have any close logic at the moment so this should be enough to get our expert. Of course, this script will generate an expert advisor with a fixed take profit, stoploss and trailing stop, something we should definitely change for the dynamically adjusted values we talked about on the earlier sections. Now you just need to click on the "complete!" button at the end of the web page and save your EA on your computer. We will heavily modify this file and return to our "expert advisor making website" in the future for further additions (closing logic, etc).

### 12.3.3 Explaining each part of the expert's code.

Now that we have a draft of our first expert advisor we should now look into the code and globally understand what is truly going on behind the curtains. If you have metatrader installed (which you should) you will find that double clicking on the file we just generated will launch the metatrader mql4 editor which is the platform we will use for further editing of the code including future additions, variable changes, etc.

You will see that the code has been commented and divided into sections so that we may easily see what each section is and what its function is. Right now it

is not extremely important to now the ins and outs of how each segment of code works but is a very good idea to take a look at the general aspects of the code and see how the expert is actually going to work when trading, that is, the overall operating scheme of the program. This is what each of the sections of the code does in very general terms :

- The first section, after the header and before the "expert initialization function" section is the place where external variables (the variables you change when backtesting or forward trading the EA are defined). If there is anything we should optimize or want to change in the future, we should add it here.

- Expert initialization function. This section tells the expert what it should do as soon as it is started. This is only executed once, when the expert is loaded on the chart.

- Expert deinitilization function. This is the opposite of the last and has code the expert should execute once when a chart is closed or when a backtest is finished.

- Expert Start Function. The main part of the expert advisor begins here, every section after this is a subsection of this Start function. This is where all the action the expert takes on every tick are defined. You should remember that the whole program is executed on every tick (all experts are).

- Variable Begin. In this section we define our internal variables. You will see that this section now contains a bunch of Buy and Sell defined variables which define the logic we previously defined on the website applet.

- Variable End. This just signals the end of the variable section

- Check Position. This part of the expert checks for open positions, if there are any opened positions, then the expert would check to see if the closing criteria is closed for any of them. In this case, the expert will just avoid further trading if there are any positions opened. The Signal Exit sections are empty because we don't have any closing logic at the time besides, TL, TP and SL. The trailing stop code is defined after the Signal end section. You should notice that two trailing stop codes are defined, one for longs and one for shorts after the pertaining Signal End sections.

- The Signal Begin (entry) tells the expert whether it should initiate a long or a short trades. The logic there is expressed as a simple conditional (a conditional is an expression that tells the program to do something if something else happens). This logic reflects the selections we made on the website applet. If the appropriate conditions are met, the Order switch is set to either SIGNAL_BUY or SIGNAL_SELL. Later on, the Buy and Sell subsections will search if the appropriate signal exists and they will open up an order given the right signaling exists and no other open positions are present.

As you can see, the overall picture of the expert advisor is pretty simple. The expert simply defines variables, checks open positions, checks entry logic and initiates trades if pertinent. For our purposes right now it is not necessary to go into more detail into the code. However we are now going to focus in how to modify the code we have to add the appropriate money management and SL, TL and TP dynamic features which our expert currently lacks.

### 12.3.4 Introducing ATR Adjustable Money Management and ATR Adjustable SL, TP and TL

This may be the culprit and the most important thing to our expert advisor's success. If you want, you can test your expert advisor as it is and you will find out that you will get at best a break even scenario when backtesting from Jan 2000. Again, I must stress the importance of testing for long periods of time (as long as we can !). Testing for shorter periods would be delusional since you might just be looking at a profitable sub period of profitability in a globally unprofitable scenario. Again, all backtesting should be done from Jan 2000, with 0 chart mismatch errors. There is a post on my website you can access that explains how to do accurate backtests from this date.

Going back to what pertains us, it is now time to add our adjustable money management, SL, TP and TL logic. The expert advisor simply uses the values defined on the external variables section (at the very beginning) to define the actual SL, TP, TL and Lots size so we should easily be able to change them by just introducing additional code that redefines them before the actual opening up of positions. It is simply a matter of adding the code shown in the image below after the end of the variable section.

```
//+------------------------------------------------------------+
//| ATR Dynamic Logic Begin                                    |
//+------------------------------------------------------------+

double ATR = iATR(NULL,1440,14,0);
double ContractSize = 100000 ;                                   1

if(ATR > 0.1)
ATR = iATR(NULL,1440,14,0)/100 ;                                 2

if(mini_account == true)
ContractSize=10000;                                             3

if(Orders_ATR ==  true)
{
StopLoss=100*Percentage_ATR_SL*ATR; TakeProfit=100*Percentage_ATR_TP*ATR; TrailingStop=100*Percentage_ATR_TL*ATR;    4
}

if(Lots_ATR ==  true)
{
Lots=Risk*0.01*AccountBalance()/(ContractSize*ATR); Lots=NormalizeDouble(Lots, 2);    5
}

if(five_digit_broker == true && Orders_ATR == true)
{
StopLoss=100*Percentage_ATR_SL*ATR*10; TakeProfit=100*Percentage_ATR_TP*ATR*10; TrailingStop=100*Percentage_ATR_TL*ATR*10;    6
}

if(five_digit_broker == true && Orders_ATR == false)
{
StopLoss=StopLoss*10 ;   TakeProfit=TakeProfit*10 ;   TrailingStop=TrailingStop*10 ;    7
}

if(backtesting == true)
Lots=NormalizeDouble(Lots, 1);                                   8

//+------------------------------------------------------------+
//| ATR Dynamic Logic End                                      |
//+------------------------------------------------------------+
```

This logic also adds a lot of variables which are not yet defined on the expert and which should be defined as external variables as it is shown on the next image.

85

```
//|            hoop://Sufx.core.co lom.hee/ExpertAdvisorBuilder/|
//|                                                              |
//|   In no event will author be liable for any damages whatsoever. |
//|                    Use at your own risk.                     |
//|                                                              |
//+------------------ DO NOT REMOVE THIS HEADER --------------------+

#define SIGNAL_NONE 0
#define SIGNAL_BUY    1
#define SIGNAL_SELL   2
#define SIGNAL_CLOSEBUY 3
#define SIGNAL_CLOSESELL 4

#property copyright "Expert Advisor Builder"
#property link      "http://sufx.core.t3-ism.net/ExpertAdvisorBuilder/"

extern double Percentage_ATR_TP = 70 ;
extern double Percentage_ATR_TL = 30 ;
extern double Percentage_ATR_SL = 50 ;
extern bool Orders_ATR = True ;          new variables
extern bool Lots_ATR = True ;
extern bool backtesting = True ;
extern bool five_digit_broker = True ;
extern bool mini_account = True ;
extern double Risk = 1.0 ;
extern int MagicNumber = 0;
extern bool SignalMail = False;
extern bool EachTickMode = True;
extern double Lots = 1.0;
extern int Slippage = 3;
extern bool UseStopLoss = True;
extern int StopLoss = 30;
extern bool UseTakeProfit = True;
extern int TakeProfit = 60;
extern bool UseTrailingStop = True;
extern int TrailingStop = 30;

int BarCount;
int Current;
bool TickCheck = False;
```

So what does this logic mean ?  I will now explain what each chunk of this logic actually means.

- Section (1) of the logic simply defines the ATR indicator which will be a daily ATR indicator calculated over a 14 day period over the current instrument, it also defines the contract size variable which is used in the formula that calculates lot sizes.

- Section (2) adjusts the ATR value if the ATR is larger than 0.1, something which must be done for pairs that only have 2 or 3 decimal places.

- Section (3) modifies the contract size if a mini account, that is, an account in which a one pip movement with a 0.01 lot position equals 1 cent, is used.

- Section (4) this section, if Orders_ATR is set to true, calculates the stoploss, take profit and trailing stop as a percentage of the ATR indicator, that is, a percentage of the average true range, this is done with the formula : 100*percentage_desired*ATR. Where percentage_desired is the percentage of the ATR you want to be SL, TL or TP and ATR is the value of the ATR defined in (1)

- Section (5) calculates lot sizes according to equity and volatility. This uses the same formula used for the turtle trading system. The formula used is defined as : Risk*0.01*Account Balance/(Contract Size*ATR) where the Risk variable multiplies the traded lot size by a certain value in order to further increase the global risk of trading. As you can see, both account balance and the value of the ATR play a role on this calculation. A higher account balance implies a higher risk while a higher volatility implies a lower risk. Of course, if market movements are going to be wider we want to trade less so that we make the same amount of equity on most market conditions, this greatly smooths equity curves and turns unprofitable systems into profitable ones (for example, the trend finder daily ATR). This section then normalizes the lot sizes so that they become appropriate for trading, that is, they must only contain 2 decimal places so that no OrderSend errors are generated.

- Section (6) fixes the SL, TP and TL if a five digit broker is used. This is achieved by multiplying their values by 10 as this is the factor by which the minimal shift in price (Point value) is reduced.

- Section (7) fixes the SL, TP and TL if a five digit broker is used but no ATR logic is used, that is, Orders_ATR is set to false.

- Section (8) renormalizes lot sizes to only one decimal place if backtesting is done since the strategy tester cannot handle the two decimal place lot sizes forward testing can. That is, backtesting would give an error for a lot size of 0.08 while this is acceptable in demo and live trading. Therefore, 0.08 as to be rounded to 0.1 for backtesting.

That wasn't very bad ! We now have our expert advisor with all our main logic coded in. This expert trades exactly as we intended and is now ready for testing, optimization and analysis. This is where the funnest part of automated trading system development begins. Now that we have a very basic system we now need to backtest it, see what trades it has done and see what has gone wrong and what we will need to do to make it trade better.

## 12.4   Analyzing an Expert Advisor

Now that we have our first expert advisor ready it is time to begin our testing of the expert advisor. Before we start it is however important that you realize the many things that must be taken into account in order to analyze and justify

changes to the expert advisor. Adding additional features and indicator filters to an expert advisors is NOT a simple matter of trying random filters until one works, it is a process that must be thought off carefully after examining the expert advisor's backtesting results. There are several things we need to analyze about our expert advisor, of particular interest are the total profit in equity percentage and the maximum draw down. We then have to think about what causes these things and what we can do to eliminate them. I will now explain in a little more detail what things contribute to each one of these two extremely important values.

### 12.4.1   Contributions to the Total Profit

The total profit is simply the sum of all the profitable trades we have got, different from the net profit in that the total profit does not take into account losing trades. The total profit of an expert advisor depends on three different things. How many trades we take, how many of those trades are winners and what is the average profit for those winners. Taking this factors into account it is easy to see that there are at least three different strategies that can increase the profit of our automated trading system.

- Increase the number of profitable trades. This approach tries to increase the number of profitable trades by increasing the number of overall trades . That is, if the overall number of trades the EA takes is larger, then more profitable trades will occur. Of course, the amount of losing trades we find should also be taken into account (see next subsection).

- Increasing the amount of profit earned per winning trade. This approach tries to increase the amount of profit simply by trying to grasp more profit per winning trade. This could also have the effect of increasing the number of loses as trades that try to get higher profits have an inherent lower probability.

- Increase the percentage of profitable trades. That is, we would like to increase the amount of profitable trades we have against break even or losing trades. However, trying to get more trades would mean we would have to increase our probability of catching a profitable trade which is also coupled with a diminishment of the average winning trade.

As you can see, the above three strategies we can follow all even out against each other as changing one is likely to affect the other. The real science in optimization

is in analyzing the losing and winning trades we get and looking if there is a statistical possibility we are missing out on. For example, if we suddenly notice that 20% of profitable trades are made on highly volatile markets but 40% of losing trades are also made on this markets then we could introduce a volatility filter that will have a net decrease in losing trades. Of course, the danger with this filters, as you can see, is that their overall effect is to reduce the total number of trades we take and therefore it can also reduce our overall profit. It becomes a matter of testing each one of the possibilities we have against what the trade analysis is giving us. When optimizing the expert advisor we are analyzing you are going to take into account each one of the above possibilities and your going to suggest one idea to use each one of these strategies to improve the profitability of the expert. Now you understand what I meant by hard work in automated trading ? You now need to go manually after a backtest and analyze the trades taken by the EA, notice when we are making loses, when we are making profits and come up with strategies to improve these particular situations.

### 12.4.2   Contributions to the Maximum Drawdown

The other important factor we are going to discuss is the maximum draw down. Most of the time it is most important to diminish market exposure rather than to try to increase the levels of profit achieved. Finally what determines the actual usefulness of a trading system is its ability to preserve capital and maintain itself out of the market when it has to. Draw down is caused mainly by three different factors, the total number of overall trades, the percentage of those that are losing and the average amount of capital lost per losing trade. So what strategies can we use to diminish draw downs after analyzing the trades produces by our automated trading system ? In analogy to what we previously said about total profits, we can use the following strategies to deal with the maximum draw down problem :

- Decreasing the total number of trades. If we diminish trades it is obvious that we will eliminate losing trades, therefore, this is a strategy to eliminate losing trades. However, depending on if more profitable than negative trades are eliminated this could actually increase the percentage of losing trades.

- Decreasing the percentage of losing trades. If we want to decrease the percentage of losing trades then we would have to decrease the tightness of our closing mechanism and therefore we would probably also expose ourselves to an increase in the average loss per losing trades.

- Decreasing the average loss. Decreasing the amount of money lost per trade can also be used to decrease the maximum draw down. However, it is worth noting that doing this will also likely increase the percentage of losing trades since we are in fact trying to decrease our market exposure per trade. For example, if a strategy uses a 50% ATR stoploss and you decide to move it to 20% to diminish your loses per trade then you are likely going to see an increase in your percentage of loses due to the simple fact that a smaller value is just easier to reach so trades that were not getting stopped before might get stopped now.

As with the total profit situation, decreasing the draw down demands a large amount of time and analysis. What filters or what measures would be adequate to decrease an automated trading systems draw down ? It depends on the particular system. Usually, you should start an analysis on losing trades by looking at the periods in which this trades happened the most and analyze why they happened. Was the SL too tight ? Was volatility too low, too high ? Was the market ranging ? was volume low ? you should ask yourself all this questions in order to come up with solutions to the problem. In the end it is very probable that the final solution will be a combination of all the above, given the fact that a drastic modification of one will of course, affect the other in the opposite way. It is very enlightening to realize how the market protects itself from systems that can "make a killing" this way. The market makes sure that any drastic measure against any of this conditions will result in a system that will eventually cause wipe outs. As an example, the system we talked about before with huge risk to reward ratios try to eliminate the draw down problem by decreasing the percentage of losing trades greatly simply by putting a very large SL. However, the market responds by increasing the system's market exposure even more by greatly increasing the average loss per trade. Any system that uses such harsh modifications is likely to fail.

As an exercise, you will also address each one of the above points for every optimization you do on the expert advisors we are developing. This will ensure that you get a serious grip and ideas about what you are doing and how trading strategies can in fact be improved. If you don't want to do that, be my guest. But I warn you, if you want to be successful in automated trading, treat it like a job, work the hours it demands, otherwise you are just VERY likely to fail. Remember the commitment you made to yourself after the first section of this ebook, remember what you ARE willing to do.

### 12.4.3   Back to our EA...   So what initial settings , what pair, what time frame?

This is always a very intriguing question. When starting to test an expert advisor like this, what should our first testing parameters be ?  How do we know which ones we could use ? Well, a good starting place is to use a 50% ATR TP and 50% ATR SL, this values will generally fall into what trends will generally do and the analysis of this trading will give us a very good idea of how to improve the expert advisor.  For now we should disable the Trailing stop and we will enable it later if we see that the trades could benefit from using it.  Now get ready for your first backtest of the first draft of the Watukushay I EA ! (remember to backtest to Jan 2000 to Jan 2009) We are not going to use the last 8 months for backtesting as we want to keep some data to test against once we finish the whole improvement process. This way we would know how this would have worked 8 months ago and it will give us a very good idea about long term profitability. Of course, if all this turns out great we would still need to check for live-back testing consistency by running a live test of at least 6 months to compare to a backtest of that exact same period of time. Meaning that we should do a backtest of the 8 months we did not test, then trade 6 months live and then do a backtest of those 6 live tested months to check for back/live testing consistency.

Another important question is to ask which currency pair and which time-frame.  I would have to say that any trend following system should be able to work on the GBP/USD or the EUR/USD as these are the pairs that have the most directional trends.  In my experience I would say that every time you test one of these systems it is better to start with one of these two pairs.  For this example we will start testing on the GBP/USD one hour chart.  We are going to use the one hour to get a similar trading frequency as the god's gift ATR since the whole goal is to make a similar or better expert advisor that trades in a similar fashion. In an important note, also remember to use a balance of 100K USD to test the strategy on the backtester to avoid any lot size calculation related errors (which could arise if a low risk is used with a small account size due to the one decimal lot size limitation).

### 12.4.4   First Backtesting Results. What can we improve ?

The WA2_1.htm file inside the Watukushay project folder shows you the result of backtesting the expert we just programmed from Jan 01 2000 to Jan 01 2009 using

the settings we previously discussed. As you can see by the equity curve, the EA is already almost completely long term profitable. You see how simple it really is to create a profitable trading system ? When you tackle a fundamental characteristic of the market and you have dynamic TP, SL, TL and lot size management, many systems become profitable. As I said before, money management is the most critical aspect of successful trading and one that we have successfully tackled with the ATR adjustable logic.

This expert however has some problems, as you can see by the graph, the expert experiences a period of almost 2 years of overall loses which in a real account would bring us into significant draw down. For example, if you repeat this backtest with a risk of 10 you will see the results in the WA2_2.htm file. As you can see, the expert realizes a 20% yearly profit but has a draw down in excess of 68%. Even more, profits are only achieved in significantly high amounts over the past two years. However, you can see how the ATR logic does protect us even when we increase risk. A linear increase in risk with any of the common money management systems (supposing they could achieve the same results, which they can't) would have multiplied risk by 10 bringing us close to account wipe out while the ATR adjustable money management is able to scale draw down to a lesser extent so we actually get better drawdown/profit relationships on higher risks (of course, the magnitude of draw downs do increase so this does not mean that it is better to trade higher risks since you are also increasing your market exposure although to a lesser extent than with traditional "money management" systems).

So how can we improve our strategy ? Some people may argue, by looking at the trades, that we are just losing lots of profit on profitable trades due to the fact that we are exiting the market too soon. The truth is, if you look at the next image, that we are truly getting only about 20% of what could be our maximum profit target on about 20% of the trades.
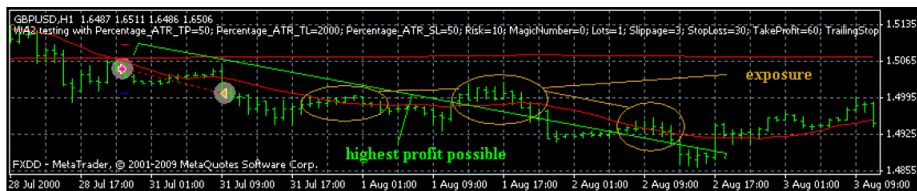
However, it is also worth noting that in order to get this profit we would need to overcome barriers and "ignore" these whipsaws until we exit the market at a more favorable level. If you try to increase the TP value by just 20%, to 70% (WA2_3.htm) you will notice that there is a significant loss of profits and an increase in draw down. This is the price that you must pay to increase the average profitable trade by 40%. So you have to bear in mind that getting these big trades will mean getting more overall losing trades, that is, the percentage of losing trades increases as you must increase your tolerance to market exposure in order to realize these higher targets. When developing these systems keep in mind that there is just a certain percentage you can reliable obtain from each trade you take, of course, this does not mean we should stop looking for strategies to let our profits run but we should also realize the limits in which we can do this. We will later see what this limit appears to be for this system.

If you closely analyze the trades taken on the first and second backtests you will notice that the most important losing periods are mainly composed of trades that go almost instantly against us because we have entered the market "too late" these trades are due to whipsaw signals from the moving averages and are part of the regular market exposure of the strategy.(an example of such losing trades is shown below)



However, we now need to think about a strategy that will allow us to exit these trades as fast as possible without getting out of our winning trades. Of course, moving the SL closer is NOT an option since doing this also affects all our profitable trades. What ideas do you have ? Before continuing, write the ideas for closing systems you think could affect only our losing trades, that is, trades that rapidly go against us. Review the previous backtests, look at the trades and think deeply about this. What can I do to exit these losing trades quickly but stay on the profitable ones ?

### 12.4.5   Adding our first additional closing mechanism

The simplest idea I could think of would be to signal an exit by the inclusion of a simple additional moving average cross of a closer MA to our trigger. That is, we can include a close MA, like a 25 period MA that could trigger closes when it crosses our 15 MA. When you have a trending market, moving average tend to go in a parallel way while when the market whipsaws we can exit a trade quickly by exiting the trade when the shorter MA crosser our trigger MA. Hopefully, this strategy would keep us from getting out when the trade is bound to be profitable since the moving averages should remain parallel. Go ahead, put a 25 MA over one of the charts of the backtests you have performed and see how it would affect trades if we exited this on close (remember, crosses must be confirmed so the same rules about using past periods apply for this exit strategy too !).

Now that we have defined what we want as a closing mechanism we have to code it into our expert advisor. Of course, coding this into the EA can have too approaches. You can either go back to the original website, add this logic into the closing sections and then read the variables and ATR logic or you can directly modify the expert advisor we already have. Since the EA is programmed in a pretty polished way, it is fairly easy to add this additional code. The first thing we would need to do is define the new closing variables in the internal variables section. For this we should add the lines of code shown on the following image.

```
//+------------------------------------------------------------------+
//| Variable Begin                                                   |
//+------------------------------------------------------------------+

double Buy1_1 = iMA(NULL, 0, 15, 0, MODE_SMA, PRICE_CLOSE, Current + 1);
double Buy1_2 = iMA(NULL, 0, 250, 0, MODE_SMA, PRICE_CLOSE, Current + 1);
double Buy2_1 = iMA(NULL, 0, 15, 0, MODE_SMA, PRICE_CLOSE, Current + 2);
double Buy2_2 = iMA(NULL, 0, 250, 0, MODE_SMA, PRICE_CLOSE, Current + 2);

double Sell1_1 = iMA(NULL, 0, 15, 0, MODE_SMA, PRICE_CLOSE, Current + 1);
double Sell1_2 = iMA(NULL, 0, 250, 0, MODE_SMA, PRICE_CLOSE, Current + 1);
double Sell2_1 = iMA(NULL, 0, 15, 0, MODE_SMA, PRICE_CLOSE, Current + 2);
double Sell2_2 = iMA(NULL, 0, 250, 0, MODE_SMA, PRICE_CLOSE, Current + 2);

double CloseBuy1_1 = iMA(NULL, 0, 15, 0, MODE_SMA, PRICE_CLOSE, Current + 1);
double CloseBuy1_2 = iMA(NULL, 0, 25, 0, MODE_SMA, PRICE_CLOSE, Current + 1);
double CloseBuy1_3 = iMA(NULL, 0, 15, 0, MODE_SMA, PRICE_CLOSE, Current + 2);
double CloseBuy1_4 = iMA(NULL, 0, 25, 0, MODE_SMA, PRICE_CLOSE, Current + 2);

double CloseSell1_1 = iMA(NULL, 0, 15, 0, MODE_SMA, PRICE_CLOSE, Current + 1);
double CloseSell1_2 = iMA(NULL, 0, 25, 0, MODE_SMA, PRICE_CLOSE, Current + 1);
double CloseSell1_3 = iMA(NULL, 0, 15, 0, MODE_SMA, PRICE_CLOSE, Current + 2);
double CloseSell1_4 = iMA(NULL, 0, 25, 0, MODE_SMA, PRICE_CLOSE, Current + 2);

//+------------------------------------------------------------------+
//| Variable End                                                     |
//+------------------------------------------------------------------+
```

Before I continue I would like to explain a little bit to you what the code actually means. For example, on the first line of code added "double CloseBuy1_1

= iMA(NULL, 0, 15, 0, MODE_SMA, PRICE_CLOSE, Current + 1) ;", what does each thing mean ? the first word, double, defines the precision and nature of the variable used. Variables can be integers, which have no decimals (like 1, 2, 3, etc) or they can be double precision number (like 1.2332432), double precision just refers to the amount of decimal precision kept when the variable is used to perform any mathematical operation. The second word CloseBuy1_1 is just the name of the variable we are defining which is defined after the "=" sign. The next word iMA, calls up the Moving Average indicator. All the resulting words between the parenthesis are just options of the iMA function, NULL refers to using the actual currency, the next 0 means using the actual timeframe, 15 is the period, the next 0 is the MA shift, the next one is the moving average mode (which can be simple, exponential, etc), the next one shows you the price that is used to calculate the MA and finally the last part, Current + 1, tells the computer we want the information of the iMA function of the first bar in the past. The semicolon at the end tells the computer we have finished the line of code and it is mandatory at the end of each instruction.

Now that things are a little bit clearer (hopefully!) regarding what we have just added we now have to add the triggering of the closing signal to the Buy and Sell closing signal sections as a function of the variables we have just defined. Add the code on the following image on the Signal Begin (Exit Buy) section.

```
if(OrderType() == OP_BUY) {
    //Close

    //+------------------------------------------------------------------+
    //| Signal Begin(Exit Buy)                                           |
    //+------------------------------------------------------------------+

    if (CloseBuy1_1 < CloseBuy1_2 && CloseBuy1_3 > CloseBuy1_4) Order = SIGNAL_CLOSEBUY;

    //+------------------------------------------------------------------+
    //| Signal End(Exit Buy)                                             |
    //+------------------------------------------------------------------+

    if (Order == SIGNAL_CLOSEBUY && ((EachTickMode && !TickCheck) || (!EachTickMode && (Bars !
        OrderClose(OrderTicket(), OrderLots(), Bid, Slippage, MediumSeaGreen);
        if (SignalMail) SendMail("[Signal Alert]", "[" + Symbol() + "] " + DoubleToStr(Bid, Dig
        if (!EachTickMode) BarCount = Bars;
```

This section should be empty before you add this line of code. The only thing this line of code does is to change the Order class to SIGNAL_CLOSEBUY which tells the EA to close an open order if the conditions specified by the if statement are true. If you take a close look at the if statement you will see that we are saying "if the 15 moving average is less than the 25 moving average one bar in the past but it was also above that average two bars in the past then signal a close". This is expressed by the > and < signs and by the && symbol which just means AND.

As an exercise, please relate each one of the variables to what it means and turn this statement by steps into an English language statement. That is, start with variable1 smaller than variable2 and variable3 greater than variable 4 and start replacing each variable by what it represents. This will give you a much clearer idea of what is going on.

Ready with that ? Now that you have introduced the Buy close trigger do the same for the Sell trigger, it should be inserted in the "Signal Begin (Exit Sell)" section. Write the sell trigger yourself and think about the meaning of the statement you are writing (check the variable names !) , also remember to replace the SIGNAL_CLOSEBUY with SIGNAL_CLOSELL at the end of the statement (also remember the semicolon at the end !).

Now it is time to test our expert advisor. Compile this version (by pressing F5 on the metatrader editor), now it is ready to be backtested ! Congratulations, you have now introduced the first closing logic of the Watukushay 1 EA ! Again, if you want to be lazy and skip all the exercises and programming and just use the experts included you should keep in mind that somebody will not be lazy and will go through everything and that person will have an edge over you in forex trading. You always have to do as much work as you can and learn as much as you can if you want to be a profitable trader.

### 12.4.6   Backtesting our new closing logic, time for our first optimization !

If everything goes well our backtest result should show the average loss should be lower than before and our percentage of profitable trades should not be affected significantly. You can see the backtesting results for this expert on the WA3_1.htm file. As you can see, we have a significant improvement of our trading results using this simple additional closing logic. The actual percentage of profitable trades remains fairly constant while the average loss decreases significantly. This means we have effectively decreased the risk to reward ratio without affecting the number of winning trades. Awesome !

You might be thinking that everything has been explained with certain detail about the closing logic except the arbitrary choice for a 25 MA on the closing logic. You are totally right, this decision was arbitrary and based on my visual inspection of about 30 different losing trades which showed that the 25 MA gave the best results, larger moving averages lag too much so we touch the SL before

triggering a close while shorter averages interact too strongly with the 15 MA and do not give us accurate closing signals. But what about 24 or 26 ? We now need to find out which is the appropriate moving average to use in our closing logic. We know it must be around 25 so what we will do now is called an optimization. What this does is to make the metatrader strategy tester do several different tests changing one or several variables in an effort to show the best trading results. Optimizations must be done for the 10 year period and this makes them computationally expensive so we will try to do as few optimizations as we can.

To start an optimization of this period we first need to make it an external variable, so that the strategy tester has something to change. In order to do this, you should change the 25 values on the internal variable definition for a variable name and then define a new variable on the initial part of the expert by using the command "extern double variable_name". Your internal variables and external variables should look something like the following images respectively. I named the new variable closing_MA_period.

```
extern double closing_MA_period = 25 ;
extern double Percentage_ATR_TP = 50 ;
extern double Percentage_ATR_TL = 30 ;
extern double Percentage_ATR_SL = 50 ;
extern bool Orders_ATR = True ;
extern bool Lots_ATR = True ;
extern bool backtesting = True ;
extern bool five_digit_broker = True ;
extern bool mini_account = True ;
extern double Risk = 1.0 ;
extern int MagicNumber = 0;
extern bool SignalMail = False;
```

```
double CloseBuy1_1 = iMA(NULL, 0, 15, 0, MODE_SMA, PRICE_CLOSE, Current + 1);
double CloseBuy1_2 = iMA(NULL, 0, closing_MA_period, 0, MODE_SMA, PRICE_CLOSE, Current + 1);
double CloseBuy1_3 = iMA(NULL, 0, 15, 0, MODE_SMA, PRICE_CLOSE, Current + 2);
double CloseBuy1_4 = iMA(NULL, 0, closing_MA_period, 0, MODE_SMA, PRICE_CLOSE, Current + 2);

double CloseSell1_1 = iMA(NULL, 0, 15, 0, MODE_SMA, PRICE_CLOSE, Current + 1);
double CloseSell1_2 = iMA(NULL, 0, closing_MA_period, 0, MODE_SMA, PRICE_CLOSE, Current + 1);
double CloseSell1_3 = iMA(NULL, 0, 15, 0, MODE_SMA, PRICE_CLOSE, Current + 2);
double CloseSell1_4 = iMA(NULL, 0, closing_MA_period, 0, MODE_SMA, PRICE_CLOSE, Current + 2);

//+------------------------------------------------------------+
//| Variable End                                               |
//+------------------------------------------------------------+
```

After doing this, you now need to recompile the expert (each time you make a change you need to !). Now you must check the optimization box on the strategy tester settings and define which variable to optimize on the "expert properties" dialog. We are going to make an optimization of this variable starting from 20 to 30 doing a +1 step on the variable on each calculation. This means that the strategy tester will run 10 different backtests from Jan 01 2000 to Jan 01 2009. Now that you have started this go and have some lunch, it may take a while ! It is now worth saying what strategy we will choose over others as a result of optimizations. In principle, we will always take the strategy with the smallest

maximum draw down as our strategy of choice as it is always our objective to have as little market exposure as possible.

After the optimization is ready (you can see the results in the W3_OPT.htm file) you will see that the best MA value for the closing parameter is actually 21. It is very worth noting that our initial strategy's draw down has been cut to almost half and its profit has been increased by a significant amount. We have managed to reduce our risk to reward ratio without reducing our overall number of trades or the quality of our profitable trades. As of now, our system fulfills almost all characteristics of a long term profitable system and our last efforts have effectively cut our profits short. The only problem now seems to be that we are not letting our profits run. Are we at the profitability limit of our system now ? Can we increase it ? We will treat this problem on the following subsection.

### 12.4.7   Letting our Profits Run

Having minimized the amount of draw down we expect from our strategy we will now focus on the other side of the strategy and try to increase our expert advisor's achieved profit levels. The first thing that came to my mind when thinking about letting profits run was quite simple, let us use a trailing stop and see how the EA performs. I also disabled the TP so that we may see how a trailing stop performs by itself. For the first test I used a value of 50% of the ATR for the TL and kept the SL at the previous value of 50%. You can check the result of this backtest by accessing the file called WA3_2.htm.

The results of the trading system changed completely as you can see on the test. The possibility of catching large trend movement appears and we see this by a great increase of the largest profitable trade which is now several times (5x) the average loss. This increase in trade profitability is however paid as an increase in the number of unprofitable trades which increases the maximum draw down considerably, from our previous results near 5.7% to a level near 7.5% and our profit levels also fall by almost 30% as the new found profitability of some trades does not cover up for the large increase in losing trades. As you can see, when you try to increase your profits you are always bound to increase your loses as well (as we discussed in previous sections), that is of course, because larger probability trades are less frequent so you have to expose yourself to more losing trades. Also notice how the average loss and the average profit trade keep a similar tendency as in the case of a fixed TP. You will notice that using a TL gives you an average

profit close to that of a TP of the same value, although TL strategies are generally more robust, in the sense that they are more flexible against changes in market conditions.

It is however evident that the trailing stop variable (as well as the TP before) are not at their optimum values, so our task will now be to try to see what the best TL or TP value would be. For this we will run two separate tests first, to see what the effects of lowering the TL to 40 and increasing it to 60 are. This will give us an idea of what direction we should move or if the optimum TL is already around 50. Increasing the TL will most likely increase the number of losing trades but it will also increase the average profit while reducing it would have the opposite effect. We need to run both tests to try to see if we are missing significant profit levels or if we are already near the right stop. Given the fact that a fixed TP cannot be discarded as the most profitable approach we will also run the same tests for a fixed TP of 40 and 60. The results can be checked by accessing the files WA_3_TL1, WA_3_TL2, WA_3_TP1 and WA_3_TP2.

By checking up the tests you can observe that our best results are obtained with the use of a fixed TP. It could be said that this strategy is better adjusted to letting profits run up to a certain point and cutting loses short by using an MA close strategy that simply prevents us from reaching the stoploss a little bit more than 15% of the time. You should notice how trying to decrease the TL generates much higher draw down levels as the number of losing trades is diminished but this does not compensate for the lack of profits caused by the reduction of the average profitable trade (opposite to the case of the TP). Some of you may wonder if this strategy works better if we just let the smaller MA cross do the trade closing job all the time, without the use of a TP or TL. As an exercise, set TP and TL to false and do a backtest. Analyze the results, open up the backtest chart and think about why you see the results you observe. Going back to the fixed TP, now that we know that the best results are between 40 and 50 we should now do an optimization run to determine what the best TP value actually is. As in the case of the moving average, we will run an optimization by a step of one between 40 and 50 for the TP variable. This optimization is found in the WA3_OPT.htm file. It is easily observed that all TP values have similar profits and draw downs with most differences being caused by 2 or 3 trades. Changing the TP of 50 for a lower one which may risk the introduction of further errors in backtesting is therefore not desirable, mainly because the gain in equity or draw down is negligible.

In an important matter, never use a TP value of less than 35 ! Doing so may generate very profitable results but this is only because one minute interpolation errors become extremely relevant on the backtests. I repeat, do NOT use small take profit or stoploss values, this will make your backtesting useless and therefore all optimization done will be totally irrelevant.

Also note that using a fixed TP and a TL makes no sense as profit will be limited by the smaller of the two. It is also likely that using a fixed TP will not let the large profitable trades the TL strategies need to make to give good results so overall, it will always be worse to use both a TP and a TL rather than just one of them. It seems that we were quiet lucky this time with the system's optimization as the initial variables seem to have been chosen very close to their optimums, this has to do with my experience with automated trading but my choices can also be explained logically. When you are trading an hour strategy, trends rarely move more than the daily ATR so trying to get profits higher than 50% of the ATR would mean small loses. Also, placing an SL of less than 50% of the ATR would generate more losing trades, on the other side, a higher SL would generate more loses since (if you have been watching the trades of the backtests you have done !) since our profitable trades are not becoming losing trades, increasing the SL would be applying the wrong strategy. As an exercise, do two backtests for the SL, one with a SL of 40 and another with an SL of 60. What changes ? What is the cause of the decrease in profitability in each case ?

### 12.4.8   Additional Modifications

With the logic ready and many variables optimized to a certain degree we must now ask ourselves if we should add anything else to try to reduce the number of losing trades, decrease the number of overall trades, etc. I believe that the system would not benefit from any inclusion of additional momentum or volatility indicator filters as I could not find a statistical favorability for any given situation. From a sample of 50 trades I took from the most predominantly losing period on the backtests I could see that trades occur as frequently in high as in low volatility and momentum so there does not seem to be an evident filter we could add to further enhance the EA. Of course, adding a filter would also reduce profits by reducing the amount of overall trades and the current trade count of 50 a year is perfect as it mimics the trading frequency of the god's gift ATR pretty well. Keep in mind that although strategies that trade less ARE more reliable and pay LESS commission they must be traded with a higher risk per trade to achieve significant

results and they must also be traded for very extended periods of time. Since I plan to discuss the Watukushay experts on my newsletters and make them prone to a lot of analysis by you (my dear readers !) I will not introduce further filters into this expert advisor (although this does NOT mean I do not like very long term strategies, I do believe they ARE good and profitable).

### 12.4.9   Wrapping up, a test with normal risk and a walk forward

Now that we have all the necessary logic and parameters within the first Watukushay EA it's now time to do a backtest of the EA with the normal equity size and risk we would have used on a live account since Jan 01 2000 until Jan 01 2009. This will give us profit and draw down targets for the past 10 years. After this, the final test of the EA will be a test from Jan 01 2009 to Sep 01 2009 to see how the expert would have actually performed for this last 9 months. With this in mind we will see if yearly draw down and profit targets where hit and we will see if the EA behaved like it did from 2000. You can find the first test in the WA_final_2000.htm file. The second test is an exercise for you so that you can see how the EA would have performed from January to September.

As you can see, we have developed a fairly decent likely long term profitable system for the GBP/USD. The system adjusts dynamically to the market by changing it's TP, SL and lot size according to the market volatility signaled by the 14 period daily ATR indicator. It is important to say that this EA CAN be subject to more optimization, testing, etc. Of course, you are extremely welcome to modify and play with the Watukushay EA 1 and see if you can make it perform better (without exploiting backtesting glitches). I will be thrilled to hear your suggestions ! (although I do expect you to have statistical information to back it up, don't suggest anything from the top of your head !)

## 12.5   The Watukushay Automated Trading System No.2 - Trading Based Solely on Price Action

After the development of the first Watukushay Project Expert Advisor I decided that I wanted to develop an EA that would be different from all the other experts I have programmed and tested before. My challenge with this new trading system would be to achieve profitable long term reliable results using a trading logic that was based on sound trading principles which lacked any input from traditional indicators to achieve its results. More precisely I wanted to code a system based

on candlestick patterns that would also help fellow traders understand how candlestick patterns are mathematically and computationally defined and how their detection is not trivial from a programming point of view. After a lot of work and careful collection of all my development efforts I am very excited to present you with this section of this ebook which deals with all the programming, analysis and conclusions of this second chapter of my Watukushay Project.

### 12.5.1 The Expert's Logic. Which Candlestick Pattern ?

As I said on the introduction to this section, my idea was to make the Watukushay No.2 automated trading system a system based on the exploitation of candlestick patterns. The first thing that came to my mind when I started to look for reliable candlestick patterns to use as trading signals is that the finding of these patterns and the reliable use of them in a mechanical trading system is not at all straightforward. Candlestick patterns depend to a great extent on the context in which they occur, more over, candlestick patterns do not tell you any possible exit targets or mechanisms, a second aspect that made the development of a candlestick based trading system harder. There is also the additional problem of choosing between reversal or continuation patterns to trade. Should we enter the market on a retracement ? Should we enter the market on a confirmation of a trend continuation ?

The first thing I thought of was to find a statistical source that could tell me the success rate and the actual expectations I could have about different candlestick patterns that ocurred in markets in general. After searching a lot I found out that some of the patterns with the highest recorded success rate seemed to be reversal patterns, more specifically patterns like a shooting star, a morning star, a hanging man or a hammer. This prompted me to program the first trading attempt using a reverse logic, aiming at taking profits from a reversal, however I was not very convinced as how I would be able to set my SL and TP or what exit mechanisms I should use to get out of trades early. A close look at the EUR/USD charts also made me wonder how the "accuracy" of this trading patterns had been measured by the studies I read. Obviously it became apparent that most of this studies defined a pattern as "accurate" if there was any sort of reversal when the pattern showed on the charts, nonetheless, it is impossible to predict the extent of this reversal with variations in the nature of the reversal from 10 to 50% of the daily ATR. As you see on the following image, the reversals can be small or non existent.
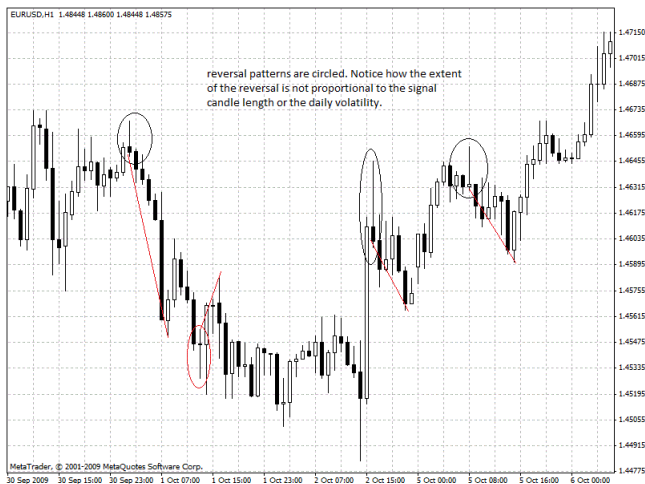
It then became clear that when a reversal pattern with high accuracy appears there is almost certainly a reversal of some sort, however the nature of such a reversal is not easily defined and to profit mechanically from entries after these reversal patterns happen would be non trivial. That is, knowing how to exit the market would be terribly hard and no obvious adaptive technique such as a percentage based ATR take profit or a signal candle length adjusted TP seemed to be up to the task. For this reason I decided that trading these reversal patterns would not be the correct way to go and I decided not to proceed with the coding of a trading system based on such trading patterns as entry signals.

It then became obvious that the only solution I had left was the implementation of continuation candlestick patterns to enter the market. From all the continuation candlestick patterns I researched I decided to code a system that used the three white soldiers and three black crows patterns as entry signals. I chose these patterns because they are easy to code and have a good accuracy as defined per the previous paragraph. This means that the white soldiers and black crows patterns most likely lead towards a trend continuation when they happen. These candlestick patterns are formed by the appearance of three consecutive long (white soldiers) or short (black crows) bars which have similar bodies in size and have short or non existent shadows (the shadow being the distance between the ends of the body and the high/low of the candle). A sample of the 3 white soldiers pattern is shown below.
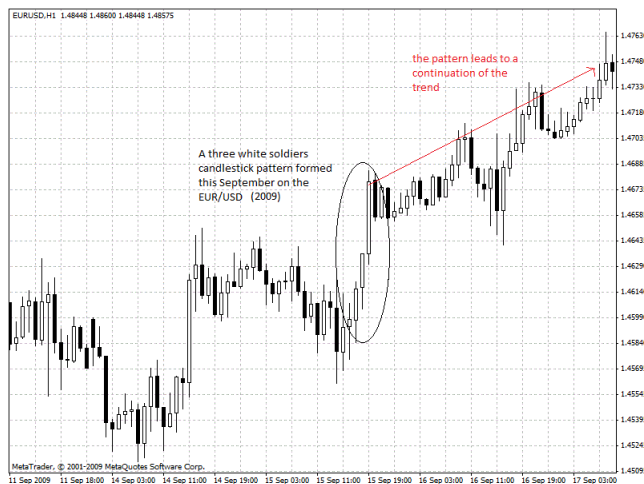


Entering on the confirmation of a continuation pattern has several advantages. First of all, we are in the direction of the trend, something which goes along with the sound trading principle of always going in favor of the long/medium term trend. Second, we do not need to know the extent of the movement since we will go with the trend until we get a confirmation which tells us that it is over and third, we can use the above mentioned reversal patterns to exit our trades in a timely fashion since the reversal patterns will signal the end of the long/short trending period. This is how I came up with the decision to choose continuation patterns as an entry criteria and reversal patterns as an exit/closing criteria. Now the question is, can we reliably translate candlestick pattern recognition to a computer program ? Can a computer distinguish patterns from the noise ? How is this

done ? All these questions will be answered during the following few sections in which the code structure will be discussed together with the analysis that lead to the inclusion or deletion of the reversal patterns used as well as the adjustment criteria used to define them.

### 12.5.2   Candlestick Pattern Definitions - How do we define these patterns ?

The next important thing we need to do is to define the candlestick patterns mathematically so that they can be incorporated into the code of our automated trading systems. The main questions we need to ask ourselves in order to define a candlestick pattern in a mathematical way are the following ones : What is the relationship between the different candlesticks composing the patterns and what are the main characteristics of each one of the candlesticks forming the pattern. In the case of the 3 white soldiers pattern we can make the following observations :

- Each one of the candles is bullish (the close is higher than the open)

- The candles have a short shadow

The first argument is easily defined mathematically :

- The close of candle one is higher than the open of candle one

- The close of candle two is higher than the open of candle two

- The close of candle three is higher than the open of candle three

The second argument is a little bit harder to define because we don't know exactly what "short" is. What is the minimum length of the shadow we need to have in order for the pattern to be valid ? In order to start my tests I decided to require each candle to have a ratio between its body (close-open) and range (high-low) which should be less than 3. This means that the body of the candle should be able to fit less than three times inside the range. This guarantees that our pattern will maintain a given ratio between its body and its range, preventing bullish candles which are of an odd shape to trigger trades. Finally it is also useful to consider the size of the candles since you will not want to enter a trade if there are three consecutive bullish candles 10 pips long during the Asian session. For this reason we must also make the body of each candle a certain "minimum" number of pips. Since it makes no sense to define the number of pips in an absolute fashion we go to the ATR indicator and define the minimum size of each candle as a set percentage of the daily 14-period average true range.
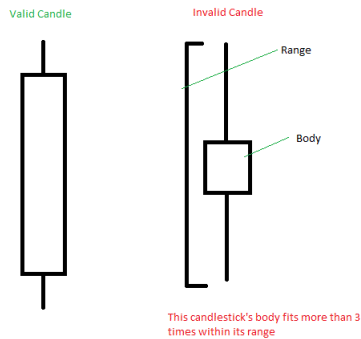
In order to include all this information in mql4 format we need to think in terms of "if" statements as we did with the Watukushay No.1 EA. Based on the Watukushay No.1 code you can do some simple modifications that will insert this logic in place of the logic of the previous expert advisor. First of all, replace the variable section with the variable section provided below, this will generate the variables we will need for the future definition of this and other candlestick patterns. You will notice that the new variables are mainly the "bodies" of the candles defined. We use the Mathabs function in order to get a positive number regardless of if the candles are bullish or bearish. The numbers between the brackets are simply the number of bars in the past [0] is the present bar, [1] is the bar before, etc.

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```
//| expert start function                                           |
//+-----------------------------------------------------------------+
int start() {
    int Order = SIGNAL_NONE;
    int Total, Ticket;
    double StopLossLevel, TakeProfitLevel;



    if (EachTickMode && Bars != BarCount) TickCheck = False;
    Total = OrdersTotal();
    Order = SIGNAL_NONE;

    //+-------------------------------------------------------------+
    //| Variable Begin                                              |
    //+-------------------------------------------------------------+

double Buy1_1 = MathAbs(High[2]-Low[2]) ;
double Buy1_2 = MathAbs(Open[2]-Close[2]) ;
double Buy2_1 = MathAbs(High[1]-Low[1]) ;
double Buy2_2 = MathAbs(Open[1]-Close[1]) ;

double Sell1_1 = MathAbs(High[2]-Low[2]) ;
double Sell1_2 = MathAbs(Open[2]-Close[2]) ;
double Sell2_1 = MathAbs(High[1]-Low[1]) ;
double Sell2_2 = MathAbs(Open[1]-Close[1]) ;

if(Buy2_2==0) Buy2_2=0.0001 ; // define Buy2_2 as 1 pip if Open and Close are the same, this avoids
                              // divide by 0 errors later on


    //+-------------------------------------------------------------+
    //| Variable End                                                |
    //+-------------------------------------------------------------+
```

After we do this we will replace the entry logic of the EA by using our candlestick definition (you also need to add a line with "extern double multatr=0.15 ;" at the beginning of the EA (where all the external variables are defined) in order to define the multatr variable) :

```
                    continue;
                }
              }
            }
          }
        }
    }

    //+-------------------------------------------------------------+
    //| Signal Begin(Entry)                                         |
    //+-------------------------------------------------------------+

    if (Close[3] > Open[3] && Close[2] > Open[2] && Close[1] > Open[1]
    && Buy1_2 > ATR*multatr && Buy2_2 > ATR*multatr && Buy2_1/Buy2_2 < 3) Order = SIGNAL_BUY ;

    if (Close[3] < Open[3] && Close[2] < Open[2] && Close[1] < Open[1]
    && Sell1_2 > ATR*multatr && Sell2_2 > ATR*multatr && Buy2_1/Buy2_2 < 3) Order = SIGNAL_SELL ;

    //+-------------------------------------------------------------+
    //| Signal End                                                  |
    //+-------------------------------------------------------------+

    //Buy
    if (Order == SIGNAL_BUY && ((EachTickMode && !TickCheck) || (!EachTickMode && (Bars != BarCount)))) {
        if(!IsTrade) {
            //Check free margin
            if (AccountFreeMargin() < (1000 * Lots)) {
                Print("We have no money. Free Margin = ", AccountFreeMargin());
                return(0);
```

There are several things you may notice about the "if" statement above which may not coincide with the definition we gave about the candles a few paragraphs above. The first obvious mismatch is the fact that we only require bars 1 and 2 in

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the past to have a certain length, bar 3 is never required to have a certain length, something which means that the third bar may be any type of bullish candle. The second one is that the ratio restriction mentioned above is only applied to bar 1 in the past and not to bars 2 and 3, something which must have been done in order to match the 3 white soldiers pattern exactly. The main reason why these changes were made by me is pretty simple, the actual exact representation of the 3 white soldier pattern is very unprofitable on the EUR/USD (as well as on other pairs such as the GBP/USD and the USD/JPY). As a matter of fact, the presence of a strict 3 white soldiers pattern is pretty rare and seldom occurs, when it does, most of the time the movement is pretty much finished and we head towards a significant retracement. However I found out that many trending periods started with the formation of a "modified" 3 white soldier pattern in which the first bar had very variable shapes, but the second and third bar always had a significant length (which I calculated to be around 10-15% of the ATR in most cases). As shown on the following picture, the candlestick patterns found that led to significant trends are shown against the ideal pattern :

Ideal Pattern

realistic patterns found
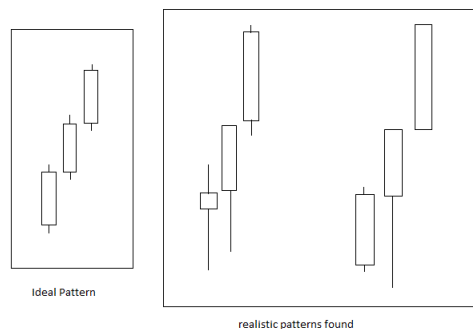
This shows us a very important lesson about the design of automated trading systems. What is written in the books about the use of candlesticks and indicators rarely works in a mechanical fashion, it requires creativity and a lot of observation to truly find the inefficiencies within the FX trading market or any market for that matter. I would like you to run backtests now using your newly developed expert advisor. Before you do so please remember to add a // in front of the "if" statements which include the Order=SIGNAL_CLOSEBUY and Order=SIGNAL_CLOSESELL statements. This will ensure that the closing logic of the Watukushay No.1 expert advisor is not used in the process. Now you should be able to compile the expert without errors and run a backtest of the EA. In order

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to first test the logic, I used a 100% ATR adjusted TP and SL. The EA you should have until now is found on the Watukushay Project folder under EA2. The EA is called WA2_1.

Now that you have run the backtests from Jan 01 2000 to Jan 01 2009 please answer the following questions. Was the EA profitable ? Where there any particular periods of time in which the EA failed dramatically ? Open up the chart with the trades and analyze the entries. How do you think this EA can be improved ?

### 12.5.3   Introducing Additional Candlestick Patterns - A Closing Criteria

You may have found through your observations of the backtests that the EA fails to grab profits when the market moves in its favor. Furthermore, many times the EA holds onto trades for very long periods of time even after the system had gone through some periods of time in which there were some obvious reversals which pointed out to an end of the medium term trend. How do we further improve this EA ? The answer is fairly simple. We need to limit our loses and let our profits run, another very sound application of traditional trading knowledge. How do we limit our loses ? The easiest answer would be to add a closing mechanism to the automated trading system. As I said in section 9.5.1, candlestick reversal patterns with high accuracy will be a very good choice to limit our loses since they will almost without failure get us out of a trade when a reversal of any magnitude is imminent.

Which candlestick pattern do we add then ? My first choice was a hammer pattern (and its bullish reversal equivalent) since my research pointed this out to be the most accurate pattern. Meaning that this is the pattern after which most of the time a reversal followed. How do we program a hammer into the system ? Ask yourself the same questions we asked at the beginning of section 9.5.2. Can you describe which things are characteristic of a hammer pattern ? What is the relationship between the body and the range ? what other characteristic can you think of ?

As you may be thinking by now, there are several ways of defining a hammer pattern. The most relevant information that I could think of was the hammer's body to range ratio and its shadow length. Opposite to the 3 soldier and 3 crow pattern, the hammer and hanging man patterns have very long shadows with short bodies. This means that we should make the shadow a minimum percentage of

the ATR and the body to range ratio larger than 3. This means that contrary to the pattern we studied before, the body of the hammer and hanging man will have to fit at least three times within its range. The shadow length must be defined in the right fashion in order to avoid odd candlesticks. For the hammer this means defining the distance from close to low as a minimum ATR percentage (opposite for the hanging man).
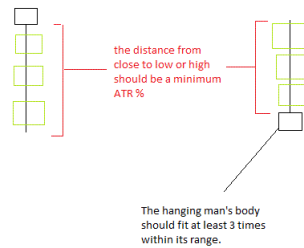


With this criteria in mind we should now replace the closing logic of the EA with the given logic that defines this trading pattern. Please replace the given "if" statements you commented before with the bits of code shown in the following image. You should also introduce the multatrhammer variable within the external variable section at the beginning of the ea by introducing the line "extern double multatrhammer=0.4 ;" (don't forget the semicolon !).

```
if(OrderType() == OP_BUY) {
    //Close

    //+------------------------------------------------------------------+
    //| Signal Begin(Exit Buy)                                           |
    //+------------------------------------------------------------------+

if( Buy2_1/Buy2_2 > 3 && High[1]-Close[1] > ATR*multatrhammer) Order = SIGNAL_CLOSEBUY ;


    //+------------------------------------------------------------------+
                    SCROLL DOWN THE CODE A LITTLE BIT
    //+------------------------------------------------------------------+
    //| Signal Begin(Exit Sell)                                          |
    //+------------------------------------------------------------------+

if( Buy2_1/Buy2_2 > 3 && Close[1]-Low[1] > ATR*multatrhammer) Order = SIGNAL_CLOSESELL ;

    //+------------------------------------------------------------------+
    //| Signal End(Exit Sell)                                            |
    //+------------------------------------------------------------------+

    if (Order == SIGNAL_CLOSESELL && ((EachTickMode && !TickCheck) || (!EachTickMode &&
        OrderClose(OrderTicket(), OrderLots(), Ask, Slippage, DarkOrange);
```

After this has been done you should be able to compile the EA without problems. If you want to see if you did anything wrong please refer to the WA2_2 expert advisor file which is the exact result you should have got up until now. After having coded our first exit logic we now need to run some new backtests on the EA to see if there is any improvement on the profitability from Jan 01 2000 to Jan 01 2009. Is there any improvement ? Why do you think I decided to set the multatrhammer variable to 0.4 (40% of the ATR) ? Open up the chart and look at the trades. You will now see that the EA is getting out of trades in a much better fashion than before, however you will also notice that the hammer and hanging man exit patterns are not enough to keep us away from most losing trades which cost the EA a significant amount of profit (specially from 2005-2009). How do we further limit our loses then ? Can you think of other reversal patterns that should be useful ? Analyze the backtest and think about the "best" exit points, what other candlestick pattern could contribute to better profitability ?

The next candlestick pattern which crossed my mind after analyzing the results obtained from the hammer/hanging man closing system were the bullish and bearish engulfing patterns. These are both high accuracy reversal patterns which are quiet common in the EUR/USD and often signal trend endings before they are signaled by hammer/hanging man patterns. The actual patterns as they ideally look in the forex market are shown below.



bearish
engulfing
pattern

bullish
engulfing
pattern
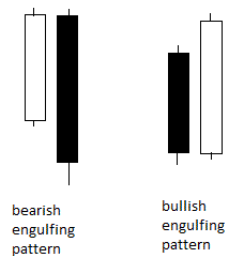
As you can see, in an engulfing pattern the second candle "swallows" the first one. The bigger the second candle is over the first one, the stronger the engulfing pattern signal is. This pattern is most likely the hardest to define up until now since it requires a very cautious positioning of the open and close values of each bar as the relative positions are vital to the adequate functioning of the candlestick

pattern. For example, for the bearish engulfing pattern you would have to fulfill the following criteria (bars are numbered from left to right):

- Open of bar 2 should be lower than the open of bar 1

- Close of bar 2 should be higher than the close of bar 1

- Close of bar 1 should be lower than open of bar 2

- Close of bar 2 should be lower than open of bar 1

- The difference between both candle's bodies should be a certain percentage of the ATR (since the higher the difference the stronger the signal we may want to only take into account signals that have a certain "strength" which is represented as a % based ATR difference between both candles)

- The difference between both candle's ranges should also be controlled to be a certain percentage of the ATR

- The difference between candle number one's range and body should also be controlled to be a certain percentage of the ATR

As you see, the first four conditions arise as necessary parameters to arrive at a pattern with the desired "positioning" while the last 3 conditions are used as a way to control the "shape" of the candlestick pattern so that we may only obtain candle formations that resemble what we want as a valid filter. The fifth and sixth conditions control the relationship between both candles while the eight controls the relationship between range and body of the last candle. This is in order to eliminate the possibility of the last candle being a hammer/hanging man type candle with a large body, something which does not account for a valid engulfing pattern.

By transcribing the statements given before into code we get the "if" statement shown below. You should add the following sections of code above the sections you added for the hammer and hanging man patterns. By introducing the additional if statements we are adding a second criteria for closing which will be triggered if the conditions for the defined candlestick pattern are met.

```
//+------------------------------------------------------------------+
//| Signal Begin(Exit Buy)                                           |
//+------------------------------------------------------------------+

    if (Open[1] > Close[2] && Close[1] < Open[2] && Open[2] < Open[1] && Close[1] < Close[2] &&
Sell1_1 - Sell1_2 < ATR*multatrengulfing && Sell2_1 - Sell2_2 < ATR*multatrengulfing
&& Sell2_2-Sell1_2 > ATR*multatrengulfing) Order = SIGNAL_CLOSEBUY;

 if( Buy2_1/Buy2_2 > 3 && High[1]-Close[1] > ATR*multatrhammer) Order = SIGNAL_CLOSEBUY ;


//+------------------------------------------------------------------+
//| Signal End(Exit Buy)                                             |
//+------------------------------------------------------------------+
                       SCROLL DOWN THE CODE

//+------------------------------------------------------------------+
//| Signal Begin(Exit Sell)                                          |
//+------------------------------------------------------------------+

    if (Open[1] < Close[2] && Close[1] > Open[2] && Open[2] > Open[1] && Close[1] > Close[2] &&
Buy1_1 - Buy1_2 < ATR*multatrengulfing && Buy2_1 - Buy2_2 < ATR*multatrengulfing
&& Buy2_2-Buy1_2 > ATR*multatrengulfing) Order = SIGNAL_CLOSESELL;

   if( Buy2_1/Buy2_2 > 3 && Close[1]-Low[1] > ATR*multatrhammer) Order = SIGNAL_CLOSESELL ;

//+------------------------------------------------------------------+
//| Signal End(Exit Sell)                                            |
//+------------------------------------------------------------------+

    if (Order == SIGNAL_CLOSESELL && ((EachTickMode && !TickCheck) || (!EachTickMode && (Bars != Ba:
        OrderClose(OrderTicket(), OrderLots(), Ask, Slippage, DarkOrange);
```

Also remember to add the multatrengulfing variable at the beginning of the
expert on the external variable section by adding the line "extern double multa-
trengulfing=0.20".  When you repeat the backtest from 2000 to 2009 you will
notice that there is a big increase in the profitability of the expert thanks to the
"cutting of loses" generated by the engulfing pattern closing mechanism. Without
a doubt the expert is now profitable from 2000 to 2009. However there are still a
few things we need to ask ourselves. Look at the trading period of 2006 to 2009
on your backtest's chart.  What do the trades have in common ?  Why were they
losing trades ? Did they fail to exit early enough ? Could they have been filtered
? does decreasing the TP to 50% of the ATR help during these periods of time ?
Stop for a while and think why these trades were unprofitable and what you would
do to try to improve them, what is the underlying reason for their unprofitability ?

### 12.5.4   Further Improving Profitability - A pair specific closing criteria

It became clear to me after several continuous days of analysis that the main cause
of loses from the period of 2006 to 2009 was that the system was facing some
very sharp reversals after it went into some profitability during periods of high
volatility. This means that the system got into trades, then there was a lot of profit
on a single bar followed by a sharp reversal which in many cases reached the SL

and caused most of the big loses that hindered profitability during the last few years of simulation. This of course could be eliminated by lowering the TP to a level near 40-50% but this of course hindered most profitable trades and made the EA become almost globally losing with its equity curve ruined from 2000 to 2004. The solution I came up with was pretty simple and eliminated the problem almost entirely . It became clear that we could simply exit trades if during a single bar the trade moved in our favor by a certain percentage of the ATR. After analyzing most of these movements I realized that this percentage was somewhere near 40%. The final logic I came up with to exit trades early is as follows (for example for exiting a short trade, opposite for a long trade):

- Close of bar 1 minus the Open of bar 1 is smaller than 0. This means that the candle is bearish

- Close of bar 2 minus the Open of bar 2 is larger than 0. This means that the candle before is bullish. I found out this was the case for most of these bars.

- Body of bar 1 is greater than a certain ATR percentage (40% was the approximate ideal I calculated from the evaluation of different trades on the backtests of the expert prior to the inclusion of this criteria. I evaluated about 70 trades between 2007 and 2009 to come out with this conclusion)

When we translate this to code we get the "if" statement shown on the below image. Please add the statements within the green rectangles below the previously added logic for the other two candlestick patterns. Also add the multatrtake variable with a value of 0.40 as you have done for the previously explained code additions. Below only the code for exiting selling trades is shown. What would be the code for exiting long trades ? As an exercise write the code yourself (based on the given code below and the other examples given before)

```
//+------------------------------------------------------------------+
//| Signal Begin(Exit Sell)                                          |
//+------------------------------------------------------------------+

    if (Open[1] < Close[2] && Close[1] > Open[2] && Open[2] > Open[1] && Close[1] > Close[2] &&
Buy1_1 - Buy1_2 < ATR*multatrengulfing && Buy2_1 - Buy2_2 < ATR*multatrengulfing
&& Buy2_2-Buy1_2 > ATR*multatrengulfing) Order = SIGNAL_CLOSESELL;

 if( Buy2_1/Buy2_2 > 3 && Close[1]-Low[1] > ATR*multatrhammer) Order = SIGNAL_CLOSESELL ;

if( Buy2_2 > ATR*multatrtake && Close[1]-Open[1] < 0 && Close[2]-Open[2] > 0) Order = SIGNAL_CLOSESELL ;

        //+------------------------------------------------------------------+
        //| Signal End(Exit Sell)                                            |
        //+------------------------------------------------------------------+

    if (Order == SIGNAL_CLOSESELL && ((EachTickMode && !TickCheck) || (!EachTickMode && (Bars != BarCount)))) {
        OrderClose(OrderTicket(), OrderLots(), Ask, Slippage, DarkOrange);
        if (SignalMail) SendMail("[Signal Alert]", "[" + Symbol() + "] " + DoubleToStr(Ask, Digits) + " Close Sell'
        if (!EachTickMode) BarCount = Bars;
        IsTrade = False;
```

What happens now ?  If you run the backtests from 2000 to 2009 you will notice that the automated trading system shows a smooth up trending equity curve that is even smoother than the one obtained from backtests of the God's gift ATR (The EA you should have coded up until now is called WA2_4).  As you see, the EA has been developed based exclusively on previous bar closes and price action and with a 100% ATR TP and SL it holds absolutely no possibility of giving erroneous backtests because of one minute interpolation errors.  Now the questions remains, is there any further room to improve the EA ? What would you do to finish the development of this automated trading system ?  What would be your final steps to the optimization of the variables of this trading system ?

### 12.5.5    Optimizing Our Trading System, Increasing Profitability

After having an overall profitable equity curve from 2000 to 2009 we should consider that our system is not at its optimum performance.  It would be extremely lucky to develop a system and have the initial values be the exact optimums for trading. In the case of our price based system it is specially true that all the ATR adjustable parameters may have better values than the values currently assigned to them.

In order to further improve the system's profitability we have to run systematic optimizations that improve our performance.  The first thing I always like to run is an optimization of the TP and SL values.  Since I had already run a backtest with a TP and SL of 50 which was unprofitable (as I said on the last section) I ran an optimization that scanned all SL and TP possibilities from 70 to 120% of the ATR in steps of 10%.  This optimization led to the optimization grid shown

below (darker results have a larger profit factor). As you can see, the EA performs profitably on almost all settings but the optimum level for the SL and the TP are around 80 for the TP and 100 for the SL, meaning that we were actually not very far from the optimum values.
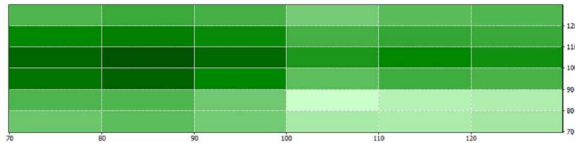


Obviously it is possible to run similar optimizations for all the ATR adjustable parameters of the EA. As an exercise, run separate optimizations for each one of the parameters varying 0.1 points in 0.01 increments from the default value -0.1 to the default value +0.1. As a result you will obtain a list depicting all the results with each test's draw down and profits. What parameter will you use to choose the parameters you need to trade ? Is it better to optimize one parameter and then optimize the other on the first optimum or optimize the second parameter also on the default settings ? What are the most profitable settings you found ? Take those settings and run 9 separate backtests, one for each year and compare each years profit and draw down, what would you expect for each year ? could you handle the year with the worst profit/ maximum draw down ?

After doing all the above exercises I found out the most profitable settings for the Watukushay No.2 expert advisors. These settings have astounded me with the most profitable results I have ever seen for a long term profitable expert advisor (expecting a 40% draw down for a 100% average yearly profit (non-compounded)). The results are better than the god's gift ATR's backtesting results and they have shown to be consistent in live trading (please watch the back/live testing consistency video for Watukushay No.2 and FE). The backtesting curve is given below (statement is also available on the expert's folder).



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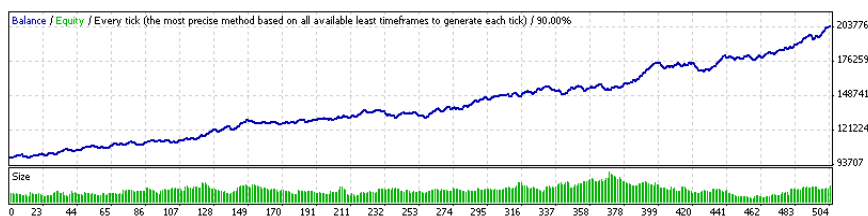
### 12.5.6   Would you like a Challenge ?

As you can see, the Watukushay No.2 is a price action based automated trading system that has achieved very profitable trading on simulation on the EUR/USD without any exploitation of backtesting faults or hindsight. The EA was carefully designed using sound trading principles and very careful and thoughtful analysis of the EUR/USD trading pair. Does the EA work on other currency pairs ? Sadly the nature of the modified trading patterns and the way they were all coded exclusively based on the EUR/USD charts makes the EA perform poorly on other currency pairs that have some other characteristic trading patterns and reversal signals. Could you do the same analysis and modify Watukushay No.2 to work profitably under other currency pairs ?

I am currently working on the analysis of additional currency pairs to achieve similar results than the ones obtained for the EUR/USD. If you would like to face this challenge you can repeat the whole process outlined here for the analysis, programming and evaluation of the Watukushay No.2 expert advisor for any additional currency pairs. Up until now I consider the USD/JPY particularly challenging since its trading patterns are very different than those of the EUR/USD. I look forward to hearing about your particular results !

## 12.6   Watukushay FE - Making a trading system For Everyone

### 12.6.1   The Objective of Watukushay FE

This expert advisor, called Watukushay For Everyone, was a trading system I decided to develop in order to give it away for free so that people would have a freely available, long term profitable alternative against commercial trading systems. I did this because I realized that there were no freely developed expert advisors which could achieve long term profitability. It became clear that people did not have access to a long term profitable alternative they could test and use in a reliable trusting fashion. For this reason I wanted to create a long term profitable system for them. I decided to make this system based on an oscillator since non of the two already developed Watukushay experts used this concept and using it on WA FE would provide additional insight about the design of long term profitable systems. The creation of this system was also very interesting in the sense that it unveiled several pitfalls of traditional EA design and paved the way for me towards a deeper understanding of oscillators such as the RSI. Through the following sections I will tell you how I designed and programmed the Watukushay FE expert advisor doing a special emphasis on the way in which I developed the trading logic of this automated trading system.

### 12.6.2   Understanding the RSI - The Trading Logic

One of the first challenges in the development of the Watukushay FE expert advisor was to find a useful market inefficiency related to the trading of the RSI indicator. The RSI, or Relative Strength Index indicator was developed by Welles Wilder in the 70s, it's currently one of the most popularly used indicators on trading software. To know how to use the RSI indicator profitably it becomes totally essential to understand the mathematical nature of the RSI, what is the RSI telling us ? how can we come up with an exploitable inefficiency from this information ?

The RSI indicator simply compares an instrument's gains against its loses for a given number of periods and then normalizes this number to give us a value between 0 and 100. The indicators is calculated in the following way (example given for the 14 period RSI) :

$$RSI = 100 - \frac{100}{1 + RS}$$

where

$$RS = \frac{Average\,Gain}{Average\,Loss}$$

and

$$Average\,Gain = EMA\,[14]\,of\,Up\,Periods$$

$$Average\,Loss = EMA\,[14]\,of\,Down\,Periods$$

if the previous close is above the last close then :

$$Up\,Period = |Current\,Close - Previous\,Close|$$

$$Down\,Period = 0$$

if the previous close is below the last close then :

$$Down\,Period = |Current\,Close - Previous\,Close|$$

$$Up\,Period = 0$$

If you look at the mathematical formula above, it becomes clear that what the RSI displays can be interpreted as the percentage of the market which is being taken by gains or loses. For example, an RSI of 50 means that the average gain and loss have been exactly the same while RSI values above 50 indicate that gains are becoming more predominant in the market (constituting a higher percentage of the change for the last X periods) while values below 50 mean the opposite (that loses are becoming predominant).

If you would want to use the RSI indicator to get into a trend then you would need to get into the market when certain movement was predominant (which is what a trend is all about). However you would also want to get into the trend on a retracement from the main trend which means that you would need the market to be at a certain extreme RSI value and then return to a more median RSI value to give you a better place of entry to enter a trend. There would also be several ways to exit the market, the first one that ocurred to me would be to exit the market upon a reentry of extreme RSI values since being here suggests that the

loses/gains have already happened and that a retracement is due to happen soon. The following image shows you an example of my idea with the Watukushay FE RSI strategy.
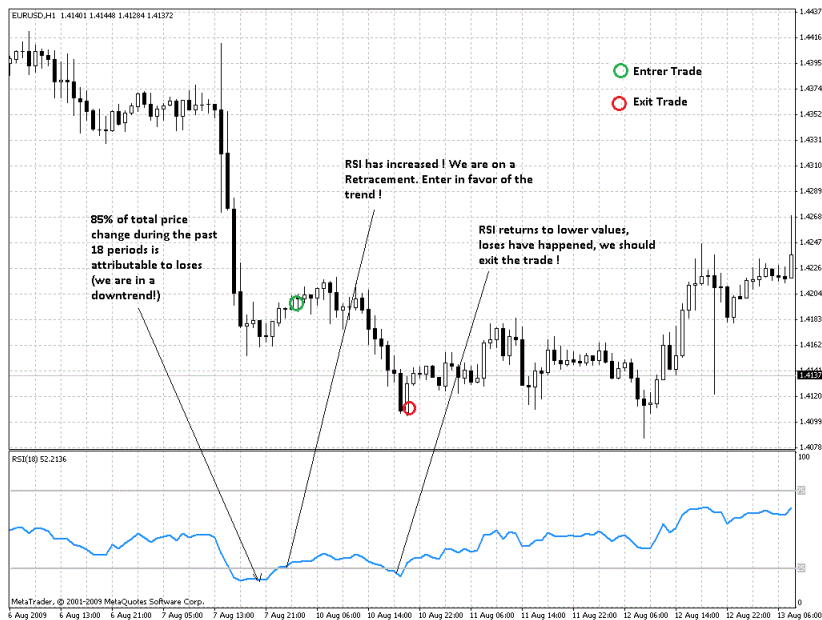


Our previous analysis also points out the reason why the main RSI strategy of buying on values below 30 and selling on values above 70 is not long term profitable. The problem with this strategy is that most of the time you will be trading against the trend and possibly the retracements that take place won't be strong enough to generate you substantial profits. The strategy above points to a straightforward way in which the RSI can be used to actually follow the trend and get into trades at a very favorable position. However many questions still remain. What RSI period do we use ? What values do we use for the exit and entry criteria ? These are all matters which I resolved through analysis of the charts and later fine-tuned through the use of system optimization. I also used ATR adjusted SL, TP and lot size values in order to further increase the adaptability of the EA and increase its profitability. The best values of these parameters were also solved through optimization as you will see within the following subsections. In the following section we will discuss the mathematical definition of the RSI logic used in Watukushay FE. How do you think this logic is defined mathematically ? How would you define the logic ? As an exercise, write the mathematical entry

and exit conditions you would use to code the above explained system. You can try first by writing sentences that say what you want to do, for example "enter a trade if the RSI value for bar 2 in the past is below X and the last bar's RSI is above X" then write a mathematical expression for this sentence.

### 12.6.3   Coding Watukushay FE

You can code Watukushay FE in several ways. I will show you now the modifications you should do over Watukushay No.1 in order to change its logic for the logic of Watukushay FE. You can also use the expert advisor builder and then add the ATR adjusted modifications as we did in the case of Watukushay No.1. There are just a few changes that need to be made in order to code Watukushay FE from Watukushay No.1. The first thing we need to do is to add the external variables we will be using later to define the RSI indicator values as well as our entry and exit parameters. You may remove the variables inherent to Watukushay No.1, such as the closing MA period we added then.

```
#property copyright "Programmed by Daniel Fernandez"
#property link      "http:fxreviews.blogspot.com"


extern double rsi_period = 18 ;
extern double sell_entry = 25 ;
extern double sell_exit = 25 ;            Introduce these lines of code.
extern double buy_entry = 75 ;            They define the variables we will be using.
extern double buy_exit = 75 ;

extern double Percentage_ATR_TP = 130 ;
extern double Percentage_ATR_TL = 30 ;
extern double Percentage_ATR_SL = 50 ;
extern double Risk= 1.0 ;
extern bool backtesting = True ;
extern bool five_digit_broker = True ;
extern bool mini_account = False ;
extern bool Orders_ATR = True ;
extern bool Lots_ATR = True ;
int MagicNumber = 0;
bool SignalMail = False;
bool EachTickMode = True;
double Lots = 1.0;
int Slippage = 3;
bool UseStopLoss = True;
int StopLoss = 30;
bool UseTakeProfit = True;
int TakeProfit = 60;
bool UseTrailingStop = False;
int TrailingStop = 30;
```

The next step in programming Watukushay FE involves the changing of the defined indicator values under the variables section. We now need to define an RSI period indicator. We need to define two RSI indicator values, one for the RSI on the previous bar and one for the RSI two bars in the past since we need to have our entries confirmed to avoid multiple entries on opened bars, therefore we need only to use information of bars closed in the past (reason why the information of the current bar is not used). Note that the rsi_period external variable defined on the previous step is used on the indicator definition to define the number of periods used for the calculation of the RSI indicator.

```
    if (EachTickMode && Bars != BarCount) TickCheck = False;
    Total = OrdersTotal();
    Order = SIGNAL_NONE;

    //+----------------------------------------------------------------+
    //| Variable Begin                                                 |
    //+----------------------------------------------------------------+


double rsinow = iRSI(NULL,0,rsi_period,PRICE_CLOSE, Current+1) ;
double rsiprev = iRSI(NULL,0,rsi_period,PRICE_CLOSE, Current+2) ;


    //+----------------------------------------------------------------+
    //| Variable End                                                   |
    //+----------------------------------------------------------------+
```

**Change the content of this section to the content shown in the green box. This is the definition of the RSI indicator values**

The next step will be to define the entry and exit logic of the RSI logic which is defined in place of the logic used on Watukushay No.1. The only thing that needs to be done is the replacement of the code within the "if" statements which define the entry and exit logic of the expert advisor. We will define the logic for the entry by entering a position when coming back from extreme RSI values. We will enter a short when the RSI is below X value and then moves above X and we will enter a long trade when the RSI is above Y and then moves below Y. The exit criteria will be upon a reentry of an extreme zone, because as I explained on the last section, a reentry of an extreme zone means that the trend has already resumed (since the RSI looks at the past) and it is time to exit the trade. So we will use mainly the same entry logic but reversed for exits. If the RSI is above A and then moves below A then close a short trade and if the RSI is below B and then moves above B then close a long trade. The values of X and Y will depend on our observation and optimization but since X,A,Y and B are extreme values our beginning parameters should definitely be above 70 for Y and B and below 30 for X and A. The following image shows the code changes necessary for the implementation.

```
    }

    //+----------------------------------------------------------------+
    //| Signal Begin(Entry)                                            |
    //+----------------------------------------------------------------+


    if (rsiprev < sell_entry && rsinow > sell_entry ) Order = SIGNAL_SELL ;

    if (rsiprev > buy_entry && rsinow < buy_entry ) Order = SIGNAL_BUY ;


    //+----------------------------------------------------------------+
    //| Signal End                                                     |
    //+----------------------------------------------------------------+

    //Buy
    if (Order == SIGNAL_BUY && ((EachTickMode && !TickCheck) || (!EachTickMode && (Bars != BarCount)))) {
        if(!IsTrade) {
```

**This code signals the entry conditions for the EA**

Now that we have the logic of the EA coded and ready to be tested it is time to ask ourselves what values we should start with on the tests. Since we are looking to catch trend movements that happen on the one hour bar between retracements it would be wise to start with SL and TP values below 100% of the ATR so we could start with a test of the SL and TP at 50% then do optimizations to find better values for this parameters. We could also start testing with a 14 period RSI and then test higher and lower periods. What values of the entry and exit parameters would you choose ? These values are the values of X,A,B and Y we discussed earlier, what parameters would you start with ? As an exercise, backtest Watukushay FE on the settings you propose. What are the results ? how would you improve the EA ? why does the EA fail on unfavorable markets ? The key to profitable trading is many times found in limiting the system's loses. How could you limit the loses of Watukushay FE ?

### 12.6.4   Testing Watukushay FE. First Observations.

You can see the first backtest I did for Watukushay FE by accessing the WAFE_1 backtest on the FE folder under the Watukushay Project main folder. What conclusions can we draw from the performance of the trading system ? Did it do what it promised ? does it have a positive mathematical expectancy ? What are favorable and unfavorable market conditions ? All of these are questions which you have to ask yourself when developing long term profitable systems. The equity curve for the backtest is shown below.The system managed to achieve a positive mathemat-

ical expectancy for the past 10 years, something which speaks very good about the trading logic used. However, the fact that the average yearly profit is only around 2% for each 11% draw down points out that there is still a lot of room for improvement. How can we improve the strategy ?
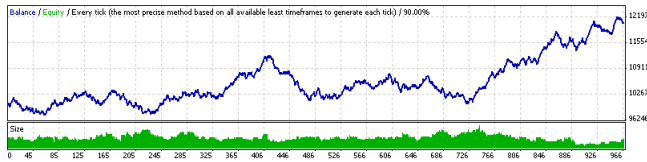


First of all, before starting to do any optimization, we should first see the trades taken and analyze different market conditions. Do the same backtest on your computer. Analyze the trades on the 2004-2005 period, why did the system have so many loses there ? What is the systems market exposure ? What are the system's weaknesses ? By analyzing the backtesting trades, we can answer these and more questions pertaining to the Watukushay FE and any other trading system. To start this analysis, let us look at the winning trades of the EA, did the EA manage to do what it was supposed to under favorable market conditions (trending markets with mild retracements) ? The following chart shows the typical profitable setup achieved by the EA during profitable market conditions.
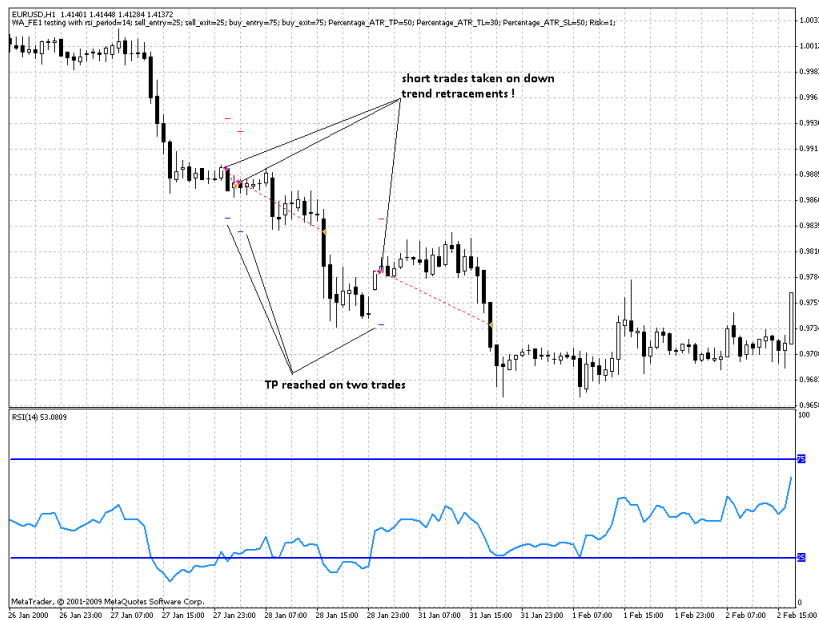
As you can see, the EA does exactly what it is supposed to when there is a clearly defined down trend on the EUR/USD. The EA enters trades on retracements of the trends at very favorable positions and exits trades accurately in proportion to market volatility as determined by the ATR. What are the losing conditions for the EA ? Tight market ranges, when the RSI becomes contracted and signals overbought or oversold conditions on markets which do not have significant volatility we get many whipsaw signals because the market is just "bouncing" off overbought and oversold zones. An example of such losing trades is given on the chart below.
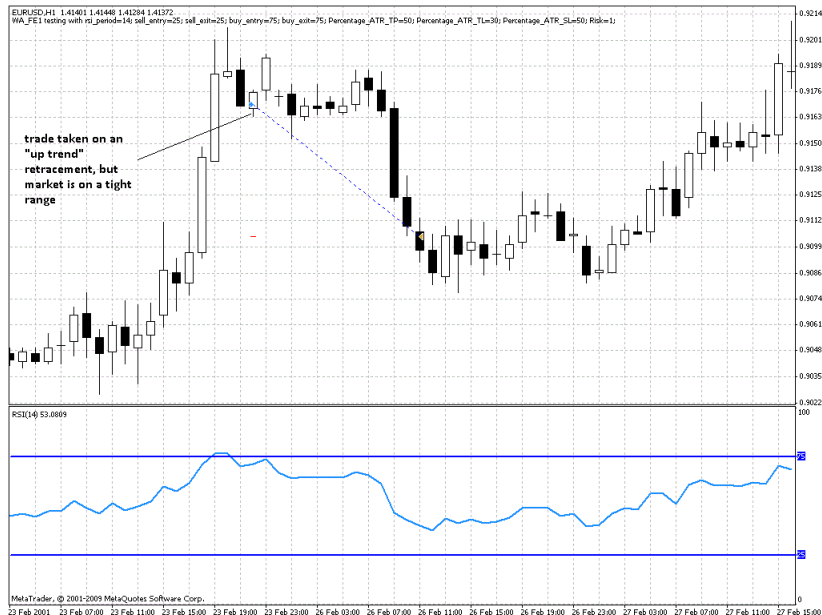


The fact that this "fake trends" were the leading cause of unprofitability on unfavorable periods prompted me to first optimize the EA towards other RSI periods to see if these unfavorable periods were less frequent or more limited on different values of the RSI. In order to measure this effect I ran an optimization of the RSI period variable from 5 to 30 in a 5 step in order to see the effect of increasing or decreasing the value of the RSI. You can see the results of this optimization as OPTRSI on the Watukushay FE folder.

As you can see by the tests, low RSI values give us unprofitable results, mainly

because the market becomes much more "blurry" with the use of fewer periods increasing the problem we had with the 14-period RSI. Higher RSI periods values have an obvious positive effect, especially regarding the draw down. As you see, the maximum draw down is reduced from 23% to less than 10% from using a 10 to a 15 period RSI, this effect continues arriving to values as low as 3% for the 30 period RSI. However this carries with it the diminishment of profitability since many trades that would have been taken on a lower period RSI are actually not taken due to the fact that the signals are "smoothed" over a longer period. This is why we see a global diminishment in the number of trades from almost 2000 on the 10 period RSI to 60 on the 30 period RSI. The optimum value for the RSI seems to be compromise of both worlds which seem to be found at around a 20 period RSI which has a 5.03% draw down maintaining about 300 trades which would give as about one trade every two weeks for a 10 year period of testing. Effectively increasing the RSI diminishes the number of unfavorable trades.

### 12.6.5 Doing Optimizations of the Entry and Exit Criteria

The next obvious step to take in order to limit loses and letting profits run is the optimization of the closing and opening parameters of the EA. Would trades benefit from being closed at a higher or lower RSI cross ? In other words, would trades benefit from having more room or less room as retracements happen ? should trades tolerate smaller or larger moves against them ? I optimized the closing criteria of long and short trades in order to find an answer to this question. However it is very important to consider the symmetry on this matter since one could introduce hindsight by simply making one value asymmetric with the other. For example, an exit level of 80 for longs and 40 for shorts would favor shorts since they are unsymmetrical regarding the 0 line. For this reason I made some coding changes to allow a single variable to change both variables symmetrically. The coding changes are highlighted on the below image.

```
#property copyright "Programmed by Daniel Fernandez"
#property link      "http:fxreviews.blogspot.com"


extern double rsi_period = 18 ;
extern double entry_sym = 28 ;        Introduction of two new external
extern double exit_sym = 25 ;         variables

extern double Percentage_ATR_TP = 130 ;
extern double Percentage_ATR_TL = 30 ;
extern double Percentage_ATR_SL = 50 ;
extern double Risk= 1.0 ;
extern bool backtesting = True ;
extern bool five_digit_broker = True ;
extern bool mini_account = False ;
extern bool Orders_ATR = True ;
extern bool Lots_ATR = True ;
int MagicNumber = 0;
bool SignalMail = False;
bool EachTickMode = True;
double Lots = 1.0;

        Continue to the Variable Section

//+------------------------------------------------------------------+
//| Variable Begin                                                   |
//+------------------------------------------------------------------+

double sell_entry = entry_sym ;       These variables define the previous
double sell_exit = exit_sym ;         sell/buy_entry/exit variables, making
double buy_entry = 100-entry_sym ;    them depend against each other,
double buy_exit = 100-exit_sym ;      guarding symmetry

double rsinow = iRSI(NULL,0,rsi_period,PRICE_CLOSE, Current+1) ;
double rsiprev = iRSI(NULL,0,rsi_period,PRICE_CLOSE, Current+2) ;
```

The next step was to optimize the newly created entry_sym and exit_sym variables in order to find the optimum parameters for entry and exit for the RSI logic used on the Watukushay FE expert advisor. I ran these optimizations between 20 and 40 for both variables using a 4 step. This allows the coverage of a very wide area on the RSI and brought invaluable information about the characteristics of the trading strategy. The result of the optimization is shown below. You can also access the optimization file - OPTENTRYEXIT - inside the expert's folder.
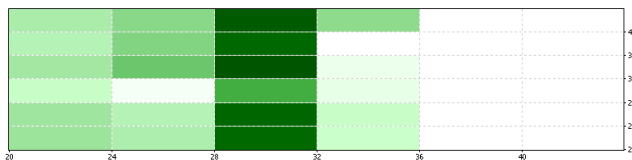
As you can see, there seems to be a limit of 28 to the entry_sym variable, level above which there are almost no profitable results. The exit criteria however seems to be quiet flexible with profitable results for all the tested values when compared against the 28 setting from the entry_sym variable. These result points out that the EA loses its positive mathematical expectancy when using entry_sym values of either 23 or 32, a fact that tells us that it is important for the system to enter trades in a retracement on the RSI towards 72 on a long trade and of 28 on a short trade. It is very important now to evaluate the equity curves of the 5 most profitable RSI settings as we need to choose our results not only in virtue of their profit/draw down levels but also in virtue of the smoothness of their equity curves. Sometimes you will find very profitable results because a few months or a single year gave a gigantic amount of profit, while the overall equity curve remains losing/flat. We want a given set of parameters with a very smooth equity curve.

Below we see the equity curves for the three most profitable settings (backtests are accessible on the expert's folder, WAFE_2a, WAFE_2b, WAFE_2c.). Notice how much the EA has improved from our first backtest thanks to an intelligently directed optimization.
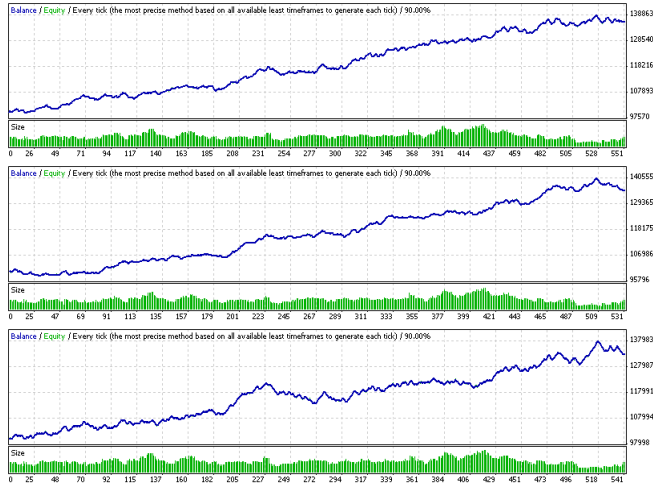


As you can see, all of them exhibit smooth equity curves with new equity highs achieved almost every year. Given the fact that all of the equity curves are smooth we choose the most profitable results to continue our tests. The most profitable result shows a maximum draw down near 3% with an average yearly profit of 3.6%. This means that we would expect to have an average yearly profit close to the maximum draw down level, a very good first profitability target for an expert advisor. It will also become obvious now to you that we are only missing the optimization of the SL and TP criteria which are clearly very important to the expert's profitability since they are the primordial factors that influence the exit criteria of the trading system. In order to determine the best TP and SL values for the EA a correlated optimization was done between the SL and TP from 30 to 70 varying each one in a step of 5 units. The test results - also contained on the OPTSLTP file - are shown on the graph below.
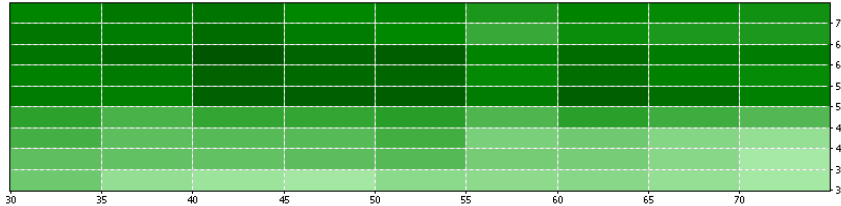
By looking at the graph above we find that incredibly a 50% ATR TP and SL is the optimum value of both parameters for the EA (it is very rare to have the first "guess" be the most profitable settings). It is important to note that some values have slightly higher profit values than the 50-50 SL/TP but those results also have significantly more draw down which does not make up for the small increase in profitability. For example, the 60-40 SL/TP setting achieves a higher profit but its draw down increases by more than 2% for an increase of less than 0.2% to the average yearly profit, a clearly bad trade off.

### 12.6.6   Further Improvements on Watukushay FE

Can the profitability of Watukushay FE be improved further ? Can it be used on more currency pairs ? As an exercise, repeat all the above analysis and optimization process for the USD/JPY and GBP/USD. Does the EA work on those currency pairs ? Why does the EA work or does work on those pairs ? What are the unfavorable and favorable periods on those currency pairs ? I will be glad to hear about any positive results you may have of Watukushay FE on other currency pairs. This will also be a great exercise for you to practice all that you've learned about EA testing and optimization. Also remember to maintain a certain degree of coarseness in your optimizations. Using very fine tuning (like optimizing a TP or SL with a step of 1) can lead to over-optimized settings and overestimated profit and underestimated draw down targets.

## 12.7   Making a Better Version Of Watukushay Experts

Although the way in which the Watukushay expert advisors have been coded is reliable from a trading and testing performance, there are still many ways in which the programming can be improved to account for more robust and reliable trading systems. Such aspects as a trading UI, functional decomposition and error handling are common traits of good programming practices and should be ideally included in our pieces of automated trading software. I have decided to leave

the explanation of the programming of these traits outside of the ebook but they will be included as optional "advanced" videos for those who are interested in the development of more advanced expert advisors from a programming point of view. The Watukushay No.2 expert advisor final version is available in both formats. The version which includes functional decomposition and UI (named WA2_EURUSD_UI) will be the version used in live testing because of its improved reliability and flexibility from a technical perspective (although both versions have the exact same logic). In the future all expert advisor's final versions will be coded in this way to account for a better user experience. The use of functional decomposition also allows for the interchangeable use of parts between different systems, an advantage when using mixed strategies.

## 12.8   More Watukushay Experts in Asirikuy

I have decided not to add further trading systems to the ebook since other Watukushay systems within Asirikuy are explained in detail within videos located in the web site's training videos. Up until now another 3 Watukushay systems have been developed, Watukushay No.3,No.4 and No.5. These systems use different trading tactics and they are both able to achieve profitable results on several different currency pairs. The results of these systems show us that the method of development being used does pave the way towards the making of many long term profitable trading strategies and that you too can arrive to similar results with adequate analysis and dedication. If you are interested in learning more about the above mentioned Watukushay systems (called Kutichiy, Teyacanani and Watukushay No.5) please go to the training section and watch their corresponding videos where their different logic aspects and coding are explained in detail :o). There are now 8 systems within Asirikuy giving us a very robust portfolio to achieve long term profitability in forex trading !

# 13   Commercial Trading Systems

## 13.1   Avoid them or not ?

As I have said in earlier sections, your probability to succeed in automated trading by using systems you do NOT really understand is almost NULL. Your success depends strongly on how much knowledge you have about the system you are trading and how you are able to change this system according to what you know to make it adapt and be profitable against several different market conditions. Since commercial expert advisor systems do NOT let you access the expert's code and do NOT explain the system to you there is a greater probability of you losing your equity because you either trade and unprofitable trading system or because you fail to control your fear and greed due to your ignorance about the trading system's logic. My advice is NOT to buy ANY commercial expert advisor. You should use an expert advisor YOU make with your knowledge of the market and trading experience or a FREE expert advisor that is WELL tested and documented like the God's Gift ATR EA.

## 13.2   What to do if you buy a commercial expert

After searching for a commercial expert advisor and finding one that MEETS ALL THE CRITERIA I have in earlier sections about choosing expert advisors it is then necessary for you to really understand it's logic in order for you to trade it with accuracy. Decompiling an EA is NOT against the law if you do so for personal use and you did not sign any EULA. After decompiling an expert advisor you will be able to look at the code and see what the EA is really doing to take it's trades.Once you know how the system really works there is a MUCH better possibility you may become profitable with this expert advisor that was programmed and designed by someone else. There are many decompiling utilities and services available on line. They will decompile the EA for a small fee or sell you the program so you can do this process yourself. Bear in mind that reading decompiled code is much harder than regular code because variable names are NOT preserved so you may need the aid of a coder to interpret and discuss the trading strategy.

## 13.3   Which one is the best commercial expert out there ?

Out of all the experts I have reviewed and tested I have found many unprofitable and unable to match my criteria for long term profitable expert advisors. I have personally evaluated hundreds of different commercial systems' trading evidence and most of them show absolutely no convincing proof of long term profitability, you can check the hundreds of reviews on my blog to learn more about these results. Most, if not all, of these experts do NOT offer live accounts with investor access and NEVER compare their backtesting to their live performance. Their strategies are also based on unsound tactics like those explained earlier in the ebook. Again, you can read some posts I have written on most of these experts by accessing my blog. Watukushay FE, which is freely available, has 10 year backtests, 8 months of live testing (WITH investor access) and a back/live testing consistency analysis. Why don't commercial EA sellers show you this information ?

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FACT : There is no single commercial EA I have found which matches my criteria for

long term profitability. There is no EA being sold with 10 year profitable backtests,

year-long live tests with investor access and tests of live/back testing consistency.

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There have only been a few expert advisors which I have found meet the necessary criteria to be tested on a demo account. One of the only ones I actually found worth buying and testing is the DTS-1 or Dreambuilder FX trading system which has been forward tested for a little bit more than 4 months with good results that accurately match backtesting results. It is worth noting that even though the DTS-1 EA is said to have a small draw down by the author with a market exposure of about 1/6 of yearly profits, several people have expressed that this value is much closer to 1/3 so beware that using the DTS-1 on it's most conservative settings would produce a maximum draw down of even 50%. As I said earlier, profitable trading systems seem to have similar market exposures and this proves to be the case. If you want to start using this system, please FOLLOW the author's instructions regarding risk and money management and do NOT increase your risk until you have traded this EA for at least a year. DTS-1 does not show back/live testing consistency with live testing results falling behind in profitability to a great extent when compared with back testing. This further points out to the fact that the profit/risk targets made by the author are overestimated. Profit targets are more in line with 20-30% per year with a 50% maximum draw down. However since a subscription is charged for the use of the EA it becomes an unattractive

investment since most profits would be invested on VPS and EA service fees for small account holders.

# 14   Conclusions

It is with great pleasure that I finish this ebook on automated trading for the forex market. It has always been my intention to help people who are new as well as experienced traders succeed in the world of forex automated trading and I really feel that I am contributing my grain of sand with this ebook. I want you all to know that I have done my greatest effort to communicate my experience to you as a successful user of automated trading systems in my forex journey. Hopefully after going through all my ebook and diligently following my advice you will be able to start to see some substantial profits from your automated trading ventures. There is still a LOT to say about automated trading systems, a reason why this ebook should be updated regularly, with at least 3 or 4 updates during the year. I would like to end this ebook wishing you all the greatest success in your automated trading careers. Thank you all very much for all your purchases !